GEOTECHNICAL ENGINEERING REPORT

St. Andrews State Park Improvements

Panama City Beach, Bay County, Florida

PREPARED FOR:

Kimley-Horn & Associates, Inc
2615 Centennial Boulevard
Suite 102
Tallahassee, Florida 32308

NOVA Project Number: 10111-2020028

March 27, 2020

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March 27, 2020

Kimley-Horn & Associates, Inc
1500 Cordova Road, Suite 300
Fort Lauderdale, Florida 33316

Subject: Geotechnical Engineering Report
St. Andrews State Park Improvements
Panama City Beach, Bay County, Florida
NOVA Project Number 10111-2020028

NOVA Engineering and Environmental LLC (NOVA) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed development to be constructed in Panama City Beach, Bay County, Florida. The work was performed in general accordance with the Standard Agreement for Professional Services between NOVA Engineering and Environmental, LLC and Kimley-Horn and Associates, Inc., dated March 12, 2020. This report briefly discusses our understanding of the project at the time of the subsurface exploration, describes the geotechnical consulting services provided by NOVA, and presents our findings, conclusions and recommendations.

We appreciate your selection of NOVA and the opportunity to be of service on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
NOVA ENGINEERING AND ENVIRONMENTAL LLC

Digitally signed by Andre Kniazeff, P.E.
DN: C=US, E=akniazeff@usanova.com, O=NOVA Engineeering, CN="Andre Kniazeff, P.E."
Date: 2020.04.21 12:22:51-05'00'

Andre Kniazeff, P.E.
Senior Geotechnical Engineer
Florida Registration No. 81315

William L. Lawrence, P.E.
Senior Regional Engineer
Florida Registration No. 60147

Copies Submitted: Addressee (electronic)

17612 Ashley Drive, Panama City Beach, Florida 32413
t. 850.249.6682 / f. 850.249.6683 / usanova.com

TABLE OF CONTENTS

1.0 SUMMARY

A brief summary of pertinent findings, conclusions and recommendations is presented below. This information should not be utilized in design or construction without reading all of the recommendations presented in the text and Appendix of this report.

1.1 GENERAL

Our field exploration at the subject site included performing twenty-nine (29) soil test borings (STBs) including: sixteen (16) Standard Penetration Test (SPT) borings drilled within the proposed structure, boardwalk, and culvert footprints and thirteen (13) auger borings drilled within the proposed stormwater management system (SMS) and pavement areas. Additionally, five (5) Double Ring Infiltrometer (DRI) tests were performed adjacent to each SMS boring location and three (3) bulk soil samples of the predominant-soil stratum present below topsoil were collected along the proposed roadway alignments for Limerock Bearing Ratio (LBR) testing. Drilling, testing and sampling operations were performed in general accordance with ASTM designations and other industry standards.

The test borings generally encountered mixed strata of very loose to very dense fine-grained sands to silty fine-grained sands (USCS classifications of SP, SP-SM, and SM) with trace to few organics (organic silt) from the existing ground surface elevation to the maximum depth explored of about 25 feet below existing grade (BEG).

1.2 SITE PREPARATION

We recommend removing all existing pavements, topsoil and surficial vegetation, trees and associated root systems, and any other deleterious non-soil materials that are found to be present from within the planned construction limits. Exposed subgrade soils at the undercut elevations, as well as subsequent lifts of fill soils, should be compacted to a minimum soil density of at least 95 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557). The top 12 inches of pavement subgrades as well as all footing excavations should be compacted to at least 98 percent.

A geotechnical engineer should carefully evaluate all subgrades prior to foundations, slabs-on-grade, and pavement sections construction to confirm compliance with this report; evaluate geotechnical sections of the plans and specifications for the overall project; and provide additional recommendations that may be required.

1.3 GROUNDWATER CONTROL

Groundwater was encountered in all SPT and SMS (DRI) borings and in auger borings P-1, P-6 and P-8 at depths ranging from about ½ foot to 9 feet BEG (with the differences in the depths to groundwater being attributed primarily to the differences in ground surface elevations at which the borings were drilled) at the time of our subsurface exploration, which occurred during a period of relatively normal seasonal rainfall. Groundwater was not encountered in the 5-foot deep auger borings P-2 through P-5 and P-7.

Depending on fill heights, groundwater could potentially impact the planned near surface construction within lower-lying areas of the site, most especially during shallow foundation and subsurface utility installations. Contractors should be prepared to utilize a temporary dewatering system during construction to maintain separation between the groundwater level and the desired working platform for below-grade work in lower-lying areas of the site.

1.4 SHALLOW FOUNDATION RECOMMENDATIONS (PROPOSED BUILDINGS AND CROSS DRAINAGE STRUCTURES)

<u>After the recommended site/subgrade preparation and fill placement</u>, we recommend that the proposed concession, restroom, pavilion and entrance station buildings and cross drainage structures be supported on conventional shallow foundation systems bearing upon compacted native soils and/or compacted structural fill. Foundations may be designed for a maximum soil bearing pressure of 1,500 pounds per square foot (psf). <u>We note that sufficient fill should be added to the lower-lying areas of the site to provide a minimum separation of at least 2 feet between the seasonal high groundwater (SHGW) table, which is estimated to occur approximately 1½ feet above the groundwater levels measured at each boring location during our field exploration, and the bottom-of-footing elevation for the lowest footings planned for the proposed buildings (not applicable to cross drainage structures).</u>

1.5 DEEP FOUNDATION RECOMMENDATIONS (BOARDWALK STRUCTURE)

As desired by the Client, a deep foundation system consisting of driven timber piles was evaluated for the proposed boardwalk structure. After the recommended site/subgrade preparation and any fill placement, the proposed boardwalk structure may be supported on the desired deep foundation system, as recommended in Section 6.4 within the body of this report.

1.6 SEAWALL (SHEET PILE WALL) RECOMMENDATIONS

Based on the results of the test borings, the subsurface conditions encountered appear to be adaptable for providing adequate support of the proposed seawall structure. Geotechnical design parameters have been included in Section 6.6 within the body of this report to aid in the sheet pile wall design.

1.7 PAVEMENT RECOMMENDATIONS

We understand that both rigid (concrete) and flexible (asphalt) pavement sections will be employed for this development. Based on the results of our test borings, the subsurface conditions encountered appear to be generally adaptable for supporting these pavement sections, provided that a minimum separation of at least 24 inches between the bottom of a crushed limerock or crushed concrete base course (for asphalt pavements) and the seasonal high groundwater table can be maintained. This separation may be reduced to 18 inches if Graded Aggregate Base (GAB) is employed for this project in lieu of crushed limerock or crushed concrete base.

1.8 STORMWATER MANAGEMENT SYSTEM RECOMMENDATIONS

NOVA understands that the proposed stormwater management system (SMS) to treat and dispose of stormwater runoff associated with the planned site development is desired to consist of five (5) conventional dry retention basins. Based on the results of our field exploration, the subsurface conditions encountered in SMS test borings DRI-1, DRI-2 and DRI-5 generally appear to be adaptable for employing the desired SMS at these specific locations. Based on the results of SMS test borings DRI-3 and DRI-4, the subsurface conditions encountered at those specific locations are deemed poorly suited for employing the desired SMS due to the presence of a very shallow groundwater table. We recommend that the soil parameters presented in Table 5 of Section 6.8 of this report be considered for the design of the overall SMS for this project.

2.0 INTRODUCTION

2.1 PROJECT INFORMATION

Our understanding of the proposed development is based on recent conversations and email exchanges with the Client, review of the provided site plan and aerial photography of the site via internet-based GIS software; our site reconnaissance activities; and our experience with similar geotechnical conditions in the near vicinity to this project site.

2.1.1 SITE PLANS AND DOCUMENTS

Architectural or structural plans were not provided to us. We were furnished with the following document:

- Document: St. Andrews State Park Redevelopment Map
  Prepared by: Kimley-Horn & Associates, Inc
  Dated: Not Dated

2.1.2 PROPOSED CONSTRUCTION

NOVA understands the proposed project will improve access to amenity areas within the existing St. Andrews State Park grounds by constructing additional recreational amenities such as concession, restroom, pavilion and entrance station buildings, new boardwalk and cross drainage structures, and repaving existing park roadways and parking lots.

We understand that the proposed buildings will be supported on conventional shallow foundation systems. Structural details were not available from the design team at the time of the issuance of this report; we have therefore assumed that maximum loadings for the proposed structures will not exceed 2 kips per lineal foot for continuous load bearing walls. The proposed boardwalk structure will be supported on a deep foundation system consisting of driven timber piles and we have assumed that the required allowable design pile capacity will be limited to 5 tons per pile.

2.1.3 SITE GRADING

Site grading details were not available from the design team at the time of the issuance of this report; we have therefore assumed that up to 3 feet of fill and no cut will be required to achieve the desired finished grade elevations within the proposed structure and pavement areas in lower-lying areas of the site.

2.2 SCOPE OF WORK

Kimley-Horn & Associates, Inc., engaged NOVA to provide geotechnical engineering consulting services for the proposed St. Andrew State Park Improvements project. This report briefly discusses our understanding of the project, describes our exploratory procedures, and presents our findings, conclusions, and recommendations.

The primary objective of this study was to perform a geotechnical exploration within the proposed construction areas and to assess these findings as they relate to geotechnical aspects of the planned site improvements. The authorized geotechnical engineering services included a soil test boring and sampling program, laboratory testing, engineering evaluation of the field and laboratory data, and the preparation of this report. The services were performed substantially as outlined in NOVA's Scope of Services and Fees (Task 1) and in general accordance with industry standards. As authorized per the above referenced proposal, this completed geotechnical report includes:

- A description of the site, fieldwork, laboratory testing and general soil conditions encountered, a Boring Location Plan, and individual Test Boring Records.
- Site preparation considerations that include geotechnical discussions regarding site stripping and subgrade preparation, and engineered fill/backfill placement.
- Recommendations for controlling groundwater and/or run-off during construction, and the need for permanent dewatering systems based on the anticipated post construction groundwater levels.
- Foundation system recommendations for the proposed structures, as appropriate based on the boring results.
- Slab-on-grade construction considerations based on the geotechnical findings, including the need for sub-slab vapor barriers or capillary barriers.
- Geotechnical design parameters to aid in the proposed seawall design.
- Recommended pavement sections based on provided or assumed traffic loading and subgrade strengths estimate from correlation with test boring, laboratory data, and soils types collected from the test borings.
- The measured apparent and estimated seasonal high groundwater levels at the boring locations.
- Recommended soil related design parameters for the SMS areas including measured infiltration rates and estimated fillable porosity values.
- Suitability of on-site soils for re-use as structural fill, backfill, and subgrade. Additionally, the criteria for suitable fill materials will be provided.
- Recommended quality control measures (i.e. sampling, testing, and inspection requirements) for site grading, pavement and foundation construction.

The assessment of site environmental conditions, including the presence of wetlands or detection of pollutants in the soil, rock or groundwater, laboratory testing of samples, or a site-specific seismic study was beyond the scope of this geotechnical study. If requested, NOVA can provide these services.

3.0 SITE DESCRIPTION

3.1 LOCATION AND LEGAL DESCRIPTION

St. Andrews State Park is located at 4607 State Park Lane in Panama City Beach, Bay County, Florida.

3.2 CURRENT USE OF THE PROPERTY

At the time of our field exploration, the Subject Property was developed as an existing state park facility.

4.0 FIELD AND LABORATORY PROCEDURES

4.1 FIELD EXPLORATION

The test boring locations were established in the field by NOVA personnel using the provided site plan and a hand-held GPS unit. Consequently, referenced boring locations should be considered approximate. If the Client desires increased accuracy, NOVA recommends that the boring locations and elevations be surveyed.

Our field exploration included performing:

- Sixteen (16) SPT borings, each advanced to a depth of approximately 25 feet BEG within the proposed structure footprints.
- Five (5) auger borings advanced to depths ranging from about 5 feet to 10 feet BEG, and five (5) DRI tests (performed adjacent to each of these borings) within the proposed SMS areas,
- Seven (7) auger borings, each advanced to a depth of approximately 5 feet BEG within the proposed pavement areas.

SPT Borings: The Standard Penetration Test borings were performed using the guidelines of ASTM Designation D-1586, "Penetration Test and Split-Barrel Sampling of Soils". A mud rotary drilling process was used to advance the borings. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2.0-inch O.D., split-tube sampler. The sampler was first seated six inches and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance". The penetration resistance, when properly interpreted, is an index to the soil strength and density. Representative portions of the soil samples, obtained from the sampler, were placed in sealed containers and transported to our laboratory for further evaluation and laboratory testing.

Auger Borings: The auger borings were performed using mechanically or hand operated soil samplers. At regular intervals, soil samples were obtained from a standard 3-inch O.D. sampler. Representative portions of the soil samples, obtained from the sampler, were placed in sealed containers and transported to our laboratory for further evaluation and laboratory testing.

Test Boring Records in Appendix B present the soil conditions encountered in the borings. These records represent our interpretation of the subsurface conditions based on the field exploration data, visual examination of the recovered samples, laboratory test data, and generally accepted geotechnical engineering practices. The stratification lines and depth designations represent approximate boundaries between various subsurface strata. Actual transitions between materials may be gradual.

Pavement Core: The pavement core was performed by advancing a 4-inch diameter, diamond core drill-bit through the existing pavement section to the underlying subgrade materials. The core was then placed in a sealed container, and transported to our laboratory where it was measured, documented and digitally photographed.

Groundwater Levels: The groundwater levels reported on the Test Boring Records represent measurements made at the completion of each test boring. The test borings were subsequently backfilled with the soil cuttings from the drilling process for safety concerns.

4.2 LABORATORY TESTING

A laboratory testing program was conducted to characterize materials existing at the site using split spoon and bulk/grab soil samples recovered from the borings. The laboratory test data are presented in the Appendix. Selected test data are presented on the Test Boring Records attached in the Appendix. The specific tests are briefly described below. Further laboratory testing was beyond the scope of this exploration. It should be noted that all soil samples will be properly disposed of 30 days following the submittal of this NOVA subsurface exploration report unless you request otherwise.

4.2.1 SOIL CLASSIFICATION

Soil classification provides a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current problems. In our explorations, samples obtained during drilling operations are observed in our laboratory and visually classified by an engineer. The soils are classified according to relative density (based on SPT N-values), color and texture. These classification descriptions are included on our Test Boring Records. The classification system discussed above is primarily qualitative; laboratory testing is generally required for detailed soil classification. Using the test results, the soils were visually/manually classified according to the Unified Soil Classification System. This classification system and the in-place physical soil properties provide an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

4.2.2 MOISTURE CONTENT

The moisture content is the ratio expressed as a percentage of the weight of water in a given mass of soil to the weight of the solid particles. This testing was conducted in general accordance with ASTM Designation D-2216. A total of eight (8) moisture content tests were performed in this study.

4.2.3 FINES CONTENT

The percentage of fines passing through the No. 200 sieve is generally considered to represent the amount of silt and clay of the tested soil sample. The sieve analysis testing was conducted in general accordance with ASTM Designations D-6913 and D-1140. A total of eight (8) fines content tests were performed in this study.

4.2.4 ORGANIC CONTENT

The organic content is the ratio expressed as a percentage of the weight of organic material in a given mass of soil to the weight of the solid particles. This testing was conducted in general accordance with ASTM D-2974. One (1) organic content test was performed in this study.

4.2.5 LIMEROCK BEARING RATIO

Three (3) bulk soil samples were obtained of the pre-dominant subsurface soils for testing in accordance with FM-5-515 – Florida Test Method for Limerock Bearing Ratio. This test method is intended for the determination of the bearing value of soils when they are compacted in the laboratory at moistures varying from the dry to wet side of optimum moisture using a 10-pound (4.54 kg) rammer dropped from a height of 18 inches (457 mm). The test is useful for evaluating limerock and other soils used for base, stabilized subgrade, and subgrade or embankment material encountered in Florida.

5.0 SUBSURFACE CONDITIONS

5.1 GEOLOGY

The site is located in Bay County, Florida and according to the United States Geological Survey (USGS), is situated within the Gulf Coastal Plain, separated from the Florida Platform by geologic structures known as the Gulf Trough and Apalachicola Embayment. These structures formed a bathymetric and environmental barrier from the earliest Eocene or earliest Oligocene periods into the Miocene.

According to the "Text to Accompany the Geologic Map of Florida" by Scott, 2001, the site is generally underlain by sediments deposited during the Holocene period. These sediments typically consist of quartz sands, carbonate sands and muds, and organics.

Surficial soils in the region are primarily siliciclastic sediments deposited in response to the renewed uplift and erosion in the Appalachian highlands to the north and sea-level fluctuations. The extent and type of deposit is influenced by numerous factors, including mineral composition of the parent rock and meteorological events.

5.2 SOIL CONDITIONS

The following paragraph provides a generalized description of the subsurface profile and soil conditions encountered by the borings. The Test Boring Records provided in the Appendix should be reviewed to provide more detailed descriptions of the subsurface conditions encountered at the boring locations. Conditions may vary at other locations and times.

The test borings generally encountered mixed strata of very loose to very dense fine-grained sands to silty fine-grained sands (USCS classifications of SP, SP-SM, and SM) with trace to few organics (organic silt) from the existing ground surface elevation to the maximum depth explored of about 25 feet below existing grade (BEG).

5.3 GROUNDWATER CONDITIONS

5.3.1 GENERAL

Groundwater in the Gulf Coastal Plain typically occurs as an unconfined aquifer condition. Recharge is provided by the infiltration of rainfall and surface water through the soil overburden. More permeable zones in the soil matrix can affect groundwater conditions. The groundwater table is expected to be a subdued replica of the original surface topography. Based on a review of topographic maps and our visual site observations, we anticipate the groundwater flow at the site to be generally towards the north, south and east.

5.3.2 Soil Test Boring Groundwater Conditions

Groundwater was encountered in all SPT and SMS (DRI) borings and in auger borings P-1, P-6 and P-8 at depths ranging from about ½ foot to 9 feet BEG (with the differences in the depths to groundwater being attributed primarily to the differences in ground surface elevations at which the borings were drilled) at the time of our subsurface exploration, which occurred during a period of relatively normal seasonal rainfall. Groundwater was not encountered in the 5-foot deep auger borings P-2 through P-5 and P-7.

Based on our review of the subsurface conditions encountered in the test borings, we estimate that the normal permanent seasonal high groundwater (SHGW) table for this property will occur approximately 1½ feet above the groundwater levels measured at each boring location during our field exploration.

Groundwater levels vary with changes in season and rainfall, construction activity, surface water runoff and other site-specific factors. Groundwater levels in the Bay County area are typically lowest in the late spring and the late fall and highest in the summer with annual groundwater fluctuations by seasonal rainfall; consequently, the water table may vary at times.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on our understanding of the proposed construction, our site observations, our evaluation and interpretation of the field and laboratory data obtained during this exploration, our experience with similar subsurface conditions, and generally accepted geotechnical engineering principles and practices.

Subsurface conditions in unexplored locations or at other times may vary from those encountered at specific boring locations. If such variations are noted during construction, or if project development plans are changed, we request the opportunity to review the changes and amend our recommendations, if necessary.

As previously noted, the client selected boring locations were established in the field by estimating distances and angles from existing site landmarks. If increased accuracy is desired by the client, we recommend that the boring locations and elevations be surveyed.

6.1 SITE PREPARATION

We recommend removing all existing pavements, topsoil and surficial vegetation, trees and associated root systems, and any other deleterious non-soil materials that are found to be present from within the planned construction limits. Exposed subgrade soils at the undercut elevations should be compacted to a minimum soil density of at least 95 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557).

A geotechnical engineer should carefully evaluate all subgrades prior to foundations, slabs-on-grade, and pavement sections construction to confirm compliance with this report; evaluate geotechnical sections of the plans and specifications for the overall project; and provide additional recommendations that may be required.

6.2 FILL PLACEMENT

6.2.1 Fill Suitability

We assume that up to 3 feet of fill will be required to achieve the desired finished subgrade elevations for the proposed structure footprints and pavement areas within lower-lying areas of the site.

Fill materials should be relatively clean sands with less than 12 percent fines (material passing the No. 200 sieve), and free of non-soil materials and rock fragments larger than 3 inches in diameter. On-site near surface soils that are categorized as fine-grained sands and slightly silty fine-grained sands (SP, SP-SM) based on the Unified Soil Classification System (USCS) are considered suitable for the use of structural fill in the building and pavement areas, provided that the materials are free of rubble, clay, rock, roots and organics.

All materials to be used for backfill or compacted fill construction should be evaluated and, if necessary, tested by NOVA prior to placement to determine if they are suitable for their intended use. Any off-site materials used as fill should be approved by NOVA prior to acquisition. Organic and/or debris-laden material is not suitable for re-use as structural fill.

6.2.2 SOIL COMPACTION

Fill should be placed in thin, horizontal loose lifts (maximum 12-inch depth) and compacted to a minimum soil density of at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). The upper 12 inches of soil beneath the bottoms of all shallow foundation footings, and the top 12 inches of subgrade soils in the pavement areas, should be compacted to at least 98 percent. In confined areas, such as utility trenches, portable compaction equipment and thinner fill lifts (3 to 4 inches) may be necessary. Fill materials used in structural areas should have a target maximum dry density of at least 100 pounds per cubic foot (pcf). If lighter weight fill materials are used, the NOVA geotechnical engineer should be consulted to assess the impact on design recommendations.

Soil moisture content should be maintained within 3 percent of the optimum moisture content. We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. Moisture control may be difficult during rainy weather. ***Soils excavated from below the groundwater table will likely require significant efforts to achieve acceptable moisture contents prior to their re-use as fill materials***.

Filling operations should be observed by a NOVA soils technician, who can confirm suitability of material used and uniformity and appropriateness of compaction efforts. He/she can also document compliance with the specifications by performing field density tests using thin-walled tube, nuclear, or sand cone testing methods (ASTM D-2937, D-6938, or D-1556, respectively). One test per 2,000 square feet in structure areas should be performed in each lift of fill, with test locations well distributed throughout the fill mass. When filling in small areas, at least one test per day per area should be performed. One (1) test at conventional spread foundations, one (1) test per lift at each planned column footing area, and one (1) test per 75 linear feet at continuous strip foundations are also recommended.

6.3 GROUNDWATER CONTROL

Groundwater was encountered in all SPT and SMS (DRI) borings and in auger borings P-1, P-6 and P-8 at depths ranging from about ½ foot to 9 feet BEG (with the differences in the depths to groundwater being attributed primarily to the differences in ground surface elevations at which the borings were drilled) at the time of our subsurface exploration, which occurred during a period of relatively normal seasonal rainfall. Groundwater was not encountered in the 5-foot deep auger borings P-2 through P-5 and P-7.

Depending on fill heights, groundwater could potentially impact the planned near surface construction within lower-lying areas of the site, most especially during shallow foundation and subsurface utility installations. Contractors should be prepared to utilize a temporary dewatering system during construction to maintain separation between the groundwater level and the desired working platform for below-grade work in lower-lying areas of the site.

The dewatering system should be capable of lowering the groundwater elevation to a minimum of 2 feet below the desired working platform elevation(s). A local contractor familiar with similar site conditions common to the Bay County area should be able to determine an adequate dewatering method for the subject property. Common local dewatering methods include, but are not limited to, dewatering by the use of temporary well points and installing temporary construction sumps and/or trench drain systems.

6.4 FOUNDATION RECOMMENDATIONS

6.4.1 General

NOVA understands the proposed project will improve access to amenity areas within the existing St. Andrews State Park grounds by constructing additional recreational amenities such as concession, restroom, pavilion and entrance station buildings as well as new boardwalk and cross drainage structures.

We understand that the proposed buildings will be supported on conventional shallow foundation systems. Structural details were not available from the design team at the time of the issuance of this report; we have therefore assumed that maximum loadings for the proposed structures will not exceed 2 kips per lineal foot for continuous load bearing walls. The proposed boardwalk structure will be supported on a deep foundation system consisting of driven timber piles and we have assumed that the required allowable design pile capacity will be limited to 5 tons per pile.

6.4.2 Shallow Foundation Systems (Proposed Buildings and Cross Drainage Structures)

Design: After the recommended site and subgrade preparation and fill placement, we recommend that conventional shallow foundation systems be used to support the proposed concession, restroom, pavilion and entrance station buildings and cross drainage structures. Foundations bearing on densified existing soils and/or compacted structural fill, as recommended in this report, may be designed for a maximum allowable bearing pressure of **1,500 pounds per square foot (psf).**

<u>We note that sufficient fill should be added to lower-lying areas of the site to provide a minimum separation of at least 2 feet between the seasonal high groundwater (SHGW) table and the bottom-of-footing elevation for the lowest footings planned for the proposed buildings (not applicable to cross drainage structures).</u>

We recommend minimum footing widths of 18 inches for ease of construction and to reduce the possibility of localized shear failures. Exterior and interior footing bottoms should be established at least 20 inches below finished surrounding exterior grades.

Settlement: Settlements for spread foundations bearing on compacted native or approved fill materials were assessed using SPT values to estimate elastic modulus, based on published correlations and previous NOVA experience. We note that the settlements presented are based on the results of the SPT borings. Conditions may be better or worse in other areas, however, we believe the estimated settlements are reasonably conservative.

Based on the soil bearing capacity provided above, and the presumed foundation elevations as discussed above, we expect primary total settlement beneath individual foundations to be on the order of 1 inch or less. The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent foundations will be on the order of ½ inch or less. The final deflected shape of the structure will be dependent on actual foundation locations and loading.

Foundation support conditions are highly erratic and may vary dramatically in short horizontal distances. It is anticipated that the geotechnical engineer may recommend a different bearing capacity upon examination of the actual foundation subgrade at numerous locations.

To reduce the differential settlement if lower consistency materials are encountered, a lower bearing capacity should be used, or the foundations should be extended to more competent materials. We anticipate that timely communication between the geotechnical engineer and the structural engineer, as well as other design and construction team members, will be required.

Construction: Foundation excavations should be evaluated by the NOVA geotechnical engineer prior to reinforcing steel placement to observe foundation subgrade preparation and confirm bearing pressure capacity. Foundation excavations should be level and free of debris, ponded water, mud, and loose, frozen, or water-softened soils. Concrete should be placed as soon as is practical after the foundation is excavated, and the subgrade evaluated. Foundation concrete should not be placed on frozen or saturated soil. If a foundation excavation remains open overnight, or if rain or snow is imminent, a 3 to 4-inch thick "mud mat" of lean concrete should be placed in the bottom of the excavation to protect the bearing soils until reinforcing steel and concrete can be placed.

6.4.3 DEEP FOUNDATION SYSTEM (BOARDWALK STRUCTURE)

Allowable pile (compression and uplift) capacities for 8-inch round driven timber piles were evaluated for this project. The estimated allowable axial compression and uplift capacities and minimum embedment depth are provided in Table 1 below.

Table 1 - Driven Timber Piles Deep Foundation Recommendations

Pile Size - Type	Embedment Depth (ft)*	Allowable Capacities* (tons)	
		Compression**	Uplift***
4” Square, Timber	10	5	0.5
4” Square, Timber	15	11	2
8” Diameter, Timber	10	13	1
8” Diameter, Timber	15	27	3

**Referenced from the existing site grade elevation and boring B-6 results.*
***Based on the Ultimate Pile Capacity and Factor of Safety of 2.*
****Based on the Ultimate Side Friction and Factor of Safety of 3.*

Installation Considerations: The pile-driving hammer should be sized to avoid overstressing the pile during driving. A drop hammer with a rated energy of 8,000 to 10,000 foot-pounds should be considered initially. NOVA should be allowed to evaluate the hammer pile system submitted by the contractor.

A minimum pile spacing of 3 diameters should be maintained. If a closer spacing is required, or if pile caps contain more than 5 piles, capacity reduction due to group effects should be considered.

Installation of driven piles, including probe and test piles should be monitored on a full-time basis. Detailed records should be maintained by the geotechnical engineer who will confirm pile size, location, installed lengths, driving resistance, tip elevation and other relevant installation information.

The engineer monitoring the installation of the production piles should be aware that the inter-layering of sandy soils and organic materials is common in the coastal areas. Our experience on projects in the surrounding area indicates that subsurface conditions can be highly erratic. If a pile(s) encounters refusal at a depth which appears to be inconsistent with the borings, probe piles or other nearby production piles, it may be necessary to replace the pile or reduce its capacity.

The installation of driving piling could adversely affect adjacent structures (if applicable). Therefore, we recommend performing pre/post inspection surveys, settlement monitoring, and vibration monitoring on any structure within a minimum distance of 100 feet of pile driving or equal to 0.5 times the square root of the impact hammer energy, in foot pounds. These structures should be monitored during all pile driving activities. Construction operations should be immediately stopped if the maximum peak particle velocity (PPV) is reached, movement of the structure is detected, or damage of the existing structures is observed.

Pile Load Test: We recommend a dynamic load testing program using PDA, including the driving of several test piles (i.e. approximately 5% of total number of production piles) in production pile locations spaced across the site to provide an indication of the potential variability in driving conditions and to confirm that the required axial capacity can be achieved in these variable conditions with the contractor's pile driving equipment. The purpose of the test pile program is to provide the contractor recommended production pile driving criteria required across the site developed based on the results and subsequent analyses of test pile program. Our experience with the PDA indicates that a significant cost savings (over static load testing of piles) may be realized if the PDA is properly utilized to monitor the installation as to pile driving stresses, capacities and integrity. Pile driving inspection is recommended for all production piles based on driving criteria developed based on the results of test pile program. Continuous driving and installation records should be maintained for each test and production pile for the geotechnical engineer's review.

Quality Control: An engineer or engineer's aide familiar with the installation of driven piles into subsurface soil conditions similar to those at this site and acting under the direction and supervision of the geotechnical engineer should witness the installation of the remaining production piles. His duties should include, but not be limited to, the following:

1. Verify that the pile or leads are either plumb or at correct batter prior to installation.
2. Keep an accurate record of pile installation and driving procedures.
3. Verify that all piles are installed to the proper driving resistance and to a depth indicative of the piles bearing in the desired bearing formation.
4. Confirm the pile driving equipment is operating properly.
5. Inspect the piles prior to installation for defects and confirm that the piles are not damaged during installation.

6.5 SLABS-ON-GRADE

The conditions exposed at subgrade levels will vary across the site and may include structural fill or densified in-situ soils. Slabs-on-grade may be adequately supported on these subgrade conditions subject to the recommendations in this report. Slabs-on-grade should be jointed around columns and along walls to reduce cracking due to differential movement. We note that sufficient fill should be added, or underdrain systems will be necessary beneath the impacted slabs, to provide a minimum separation of at least 2 feet between the bottom-of-slab elevation(s) and the post development seasonal high groundwater level. Impermeable vapor barriers are recommended beneath finished spaces to reduce dampness. Once grading is completed, the subgrade can be exposed to adverse construction activities and weather conditions during the period of sub-slab utility installation. The subgrade should be well drained to prevent the accumulation of water. If the exposed subgrade becomes unstable, excessively wet or exhibits excessive rutting or pumping, the geotechnical engineer should be consulted.

6.6 SEAWALL (SHEET PILE WALL) RECOMMENDATIONS

Geotechnical information to aid in the sheet pile design for the proposed seawall is presented below in Table 2.

Table 2 – Soil Design Parameters

Approximate Depth (ft)		Average SPT 'N' Value	Effective Unit Weight* (pcf)	Friction Angle (degrees)
From	To			
0	4	9	110	31
4	17	7	45	30
17	25	13	50	32

Based on Boring B-16 results.

Environmental Classification: we recommend the most aggressive conditions be assumed for design purposes.

6.7 PAVEMENT RECOMMENDATIONS

6.7.1 ASPHALT AND CONCRETE SURFACE OBSERVATIONS

Surface distresses inclusive of rutting, wide-spread block cracking, transverse cracking, longitudinal cracking, alligator cracking, previously patched areas, and isolated overlay areas were observed during our field exploration, and are reflected in the photographs presented in Appendix B. The asphalt/concrete distresses were observed in varying degrees from moderate to severe along the various roadway alignments/parking areas included in this study. The majority of cracks visible at the existing pavement surface appeared to extend the full depth of the concrete or asphaltic concrete sections.

6.7.2 Milling & Overlay Considerations

As previously mentioned, the existing roadway alignments/parking areas are experiencing varying stages of severe distress as evidenced by observations of cracking, rutting, and patching. Factors most likely contributing to the pavement failures and distresses include the age of the pavement section, thickness and composition of the pavement section, and/or changes (increases) in traffic loading from the initial roadway design. Given that the distresses (cracks) visible at the existing pavement surface appeared to extend the full depth of the asphaltic concrete section, together with the possible absence of a base course, ***it is our professional opinion that milling the existing asphalt wearing surface and overlaying with a new asphaltic concrete wearing surface is not a viable option for the subject pavements.***

6.7.3 Pavement Design Criteria

A recommended flexible pavement section has been developed for this project based on our understanding of the existing subsurface conditions, review of applicable FDOT specifications, and the assumed requirements of a 20-year pavement design life with moderate traffic loadings appropriate to a facility of this size and type.

6.7.4 Flexible Pavement

Recommended flexible pavement sections associated with full depth rehabilitation have been developed for this project based on our understanding of the existing subsurface conditions, review of applicable FDOT specifications, and assumed traffic loadings appropriate for this facility.

We recommend a minimum compaction requirement of 98 percent of the maximum dry density be specified for the base and stabilized subgrade courses as determined by the Modified Proctor test method (ASTM D-1557). A minimum separation of at least 24 inches between the bottom of a crushed limerock or crushed concrete base course and the seasonal high groundwater table should be maintained. This separation may be reduced to 18 inches if Graded Aggregate Base (GAB) is employed for this project in lieu of crushed limerock or crushed concrete base.

We recommend employing the parameters presented on the next page in Table 3 for the flexible pavement section design for this project.

Table 3 – Recommended Standard Duty Flexible Pavement Section	
STANDARD DUTY PAVEMENT SECTION	
Asphaltic Concrete Surface Course (such as a 9.5 mm SuperPave approved FDOT mix)	1 inch
Asphaltic Concrete Structural Course (such as a 9.5 mm SuperPave approved FDOT mix)	1 inch
FDOT Approved Crushed Limerock, Crushed Concrete, or Graded Aggregate Base (GAB) Material	6 inches
Stabilized Subgrade Course (minimum LBR of 40)	12 inches

Based on limited laboratory testing of the near-surface materials encountered in the pavement borings P-1, P-3, and P-6, it appears that the native sandy soils should meet the minimum LBR requirement of 40 for the stabilized subgrade course (SSC), but we note that the thickness of these materials in some pavement borings is not sufficient to comply with the FDOT requirements and therefore stabilization of the native subgrade soils to a depth of 12 inches should be anticipated as being needed for this project if the pavement sections will be installed at/near current site grade elevations. An imported material having a minimum LBR value of 40 should be specified for the final (12-inch) lift of fill for pavement areas being installed over fill.

All asphalt material and paving operations should meet applicable specifications of the Asphalt Institute and Florida Department of Transportation. A NOVA technician should observe placement and perform density testing of the stabilized subgrade course, base course material and asphalt.

6.7.5 <u>RIGID PAVEMENT SECTION RECCOMENDATIONS (BOAT RAMP AREA)</u>

For a rigid (concrete) pavement subgrade, we recommend using a relatively clean fine sand fill with less than 5 percent fines (material passing the No. 200 sieve – USCS classification SP materials), densified to at least 98 percent of Modified Proctor test maximum dry density (ASTM D-1557) without additional stabilization, with the following stipulations:

- At least 18 inches of free-draining (permeability of at least 5 ft/day) subgrade soils must be provided and densified to at least 98 percent of the Modified Proctor test method (ASTM D-1557) prior to placement of concrete. The free-draining subgrade must have a suitable exit point where trapped water can be relieved by either seepage or an under-drain system.

- The surface of the subgrade soils must be smooth, and any disturbances or wheel rutting corrected prior to placement of concrete.
- The subgrade soils must be moistened prior to placement of concrete.
- Concrete pavement thickness should be uniform throughout, with exception to thickened edges (curb or footing).
- The bottom of the pavement should be separated from the estimated typical wet season groundwater level by at least 24 inches.

Our recommendations for slab thickness for the concrete pavement are based on the subgrade soils being densified to 98 percent of the Modified Proctor test method (ASTM D-1557), employment of a design modulus of subgrade reaction (k) equal to 100 pounds per cubic inch, and an assumed 20-year design life. We recommend using the designs shown in Table 4 below for concrete (rigid) pavement sections.

Table 4 - Recommended Rigid Pavement Sections		
HEAVY DUTY PAVEMENT SECTION		
Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Saw-Cut Depth
6 inches	12 feet x 12 feet	1¼ inches

We recommend using concrete with a minimum 28-day compressive strength of 4,000 pounds per square inch (psi) and a minimum 28-day flexural strength (modulus of rupture) of at least 600 psi, based on 3rd point loading of concrete beam test samples. Layout of the saw cut control joints should form square panels, and the depth of saw cut joint should be ¼ of the concrete slab thickness. The joints should be sawed within six hours of concrete placement or as soon as the concrete has developed sufficient strength to support workers and equipment.

We recommend allowing NOVA to review and comment on the final concrete pavement design, including section and joint details (type of joints, joint spacing, etc.), prior to the start of construction. For further details on concrete pavement construction, please reference the “Guide to Jointing on Non-Reinforced Concrete Pavements” published by the Florida Concrete and Products Associates, Inc. (ACPA), and “Building Quality Concrete Parking Areas”, published by the Portland Cement Association.

6.8 STORMWATER MANAGEMENT SYSTEM RECOMMENDATIONS

NOVA understands that the proposed stormwater management system (SMS) to treat and dispose of stormwater runoff associated with the planned site development is desired to consist of five (5) conventional dry retention basins. Based on the results of our field exploration, the subsurface conditions encountered in SMS test borings DRI-1, DRI-2 and DRI-5 generally appear to be adaptable for employing the desired SMS at these specific locations. Based on the results of SMS test borings DRI-3 and DRI-4, the subsurface conditions encountered at those specific locations are deemed poorly suited for employing the desired SMS due to the presence of a very shallow groundwater table.

Provided the design team elects to proceed with the proposed SMS design, we recommend that the soil parameters presented below in Table 5 be considered for the design of the overall SMS for this project. We note, however, that if these parameters prove insufficient for an adequate SMS design, then consideration should be given to employing an alternate SMS design (e.g., designing the ponds for wet detention).

Table 5 – SMS Soil Design Parameters

Corresponding Soil Boring Test Locations	DRI-1	DRI-2	DRI-3	DRI-4	DRI-5
Approximate Depth to Confining Layer, feet BEG*	25	25	25	25	25
Measured Vertical Unsaturated Infiltration Rate, in/hour**	63	65	40	39	58
Calculated Lateral Hydraulic Conductivity, ft/day**	280	292	180	176	260
Estimated Fillable Porosity of Soil	25%	25%	25%	25%	25%
Estimated Depth to Normal Permanent SHGW table, feet BEG	±3½	±4	±1¾	±1½	±7½
Estimated Depth to Normal Permanent SLGW table, feet BEG	±6½	±7	±4¾	±4½	±10½

** Based on the results of nearby SPT Borings*
*** Factors of Safety have not been applied to the noted hydraulic conductivity and infiltration values*

The estimated normal permanent seasonal high groundwater (SHGW) and seasonal low groundwater (SLGW) levels provided in Table 5 above are based on our experience with projects in this locale; the soil strata encountered in our borings; the groundwater levels measured at the site; and the published information by the "Web Soil Survey" National database, NRCS division of the United States Department of Agriculture (USDA).

7.0 CONSTRUCTION OBSERVATIONS

7.1 SHALLOW FOUNDATIONS

Foundation excavations should be level and free of debris, ponded water, mud, and loose, frozen or water-softened soils. All foundation excavations should be evaluated by a NOVA geotechnical engineer prior to reinforcing steel placement to observe foundation subgrade preparation and assess bearing pressure capacity. Due to variable site subsurface and construction conditions, some adjustments in isolated foundation bearing pressures, depth of foundations or undercutting and replacement with controlled structural fill may be necessary.

7.2 DEEP FOUNDATIONS

Installation of test and production piles should be monitored on a full-time basis by a NOVA representative. Detailed records should be maintained by the geotechnical engineer who will confirm pile size, location, date of installation, and rate of penetration.

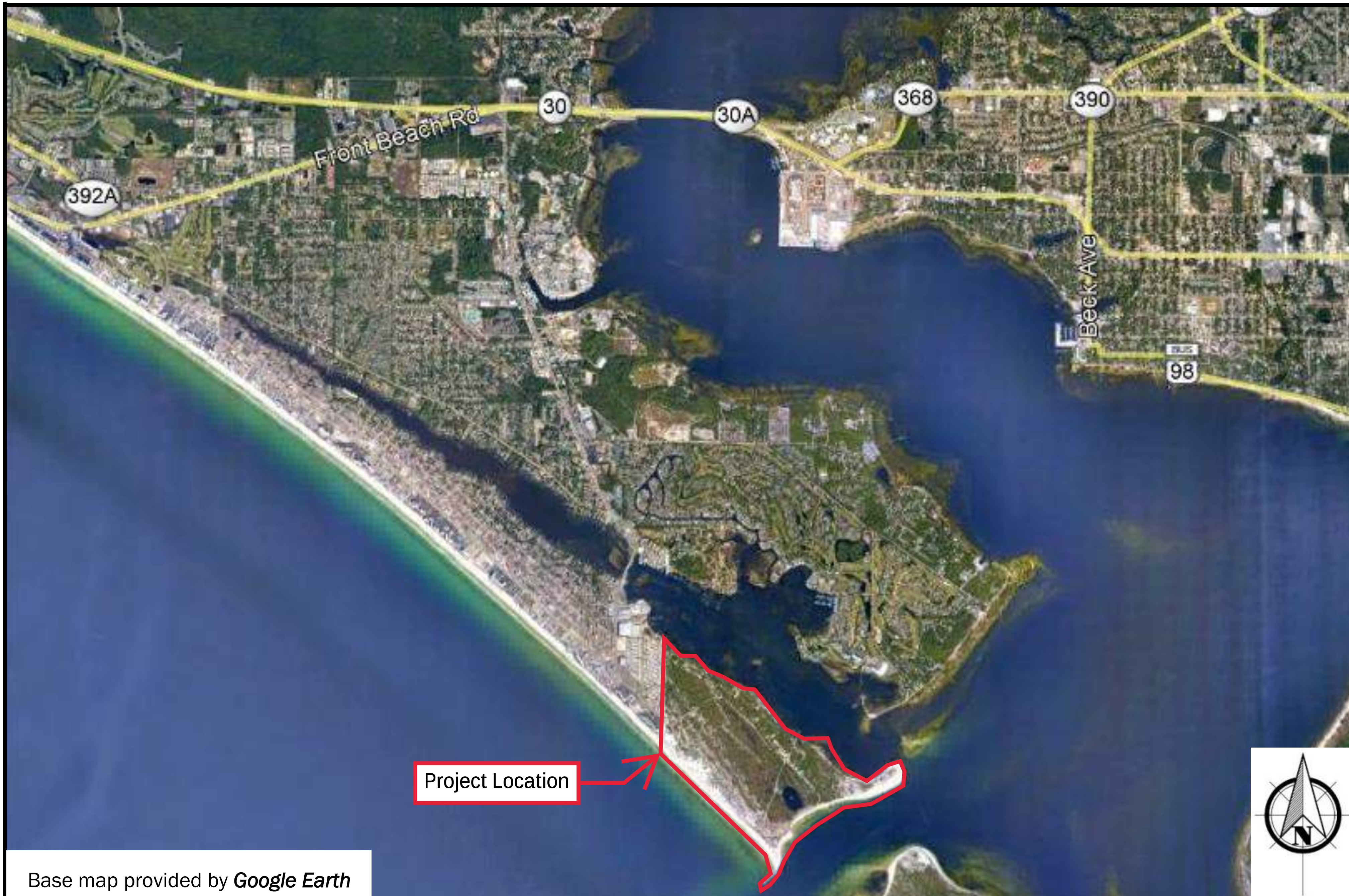
7.3 PAVEMENTS

We recommend the pavement design be performed in accordance with the FDOT Flexible Pavement Design Manual and the method and placement of materials be in accordance with the Florida Department of Transportation Standard Specifications for Road and Bridge Construction (latest edition). NOVA should be retained during construction to confirm subgrade conditions are as anticipated and that the construction process is as required by the contract documents.

7.4 SUBGRADE

Once site grading is completed, the subgrade may be exposed to adverse construction activities and weather conditions. The subgrade should be well-drained to prevent the accumulation of water. If the exposed subgrade becomes saturated or frozen, the NOVA geotechnical engineer should be consulted.

APPENDIX A
Figures and Maps



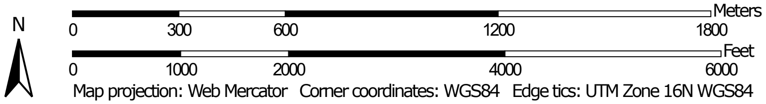
Scale: Not To Scale
Date Drawn: March 19, 2020
Drawn By: D. Ritzel
Checked By: A. Kniazeff

NOVA
17612 Ashley Drive
Panama City Beach, Florida 32413
850.249.6682 ♦ 850.249.6683

PROJECT LOCATION MAP
St. Andrews State Park Improvements
Panama City Beach, Bay County, Florida
NOVA Project Number 10111-2020028

Soil Map—Bay County, Florida
(St. Andrews State Park Improvements, 10111-2020028)

Map Scale: 1:21,300 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Florida
Survey Area Data: Version 19, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

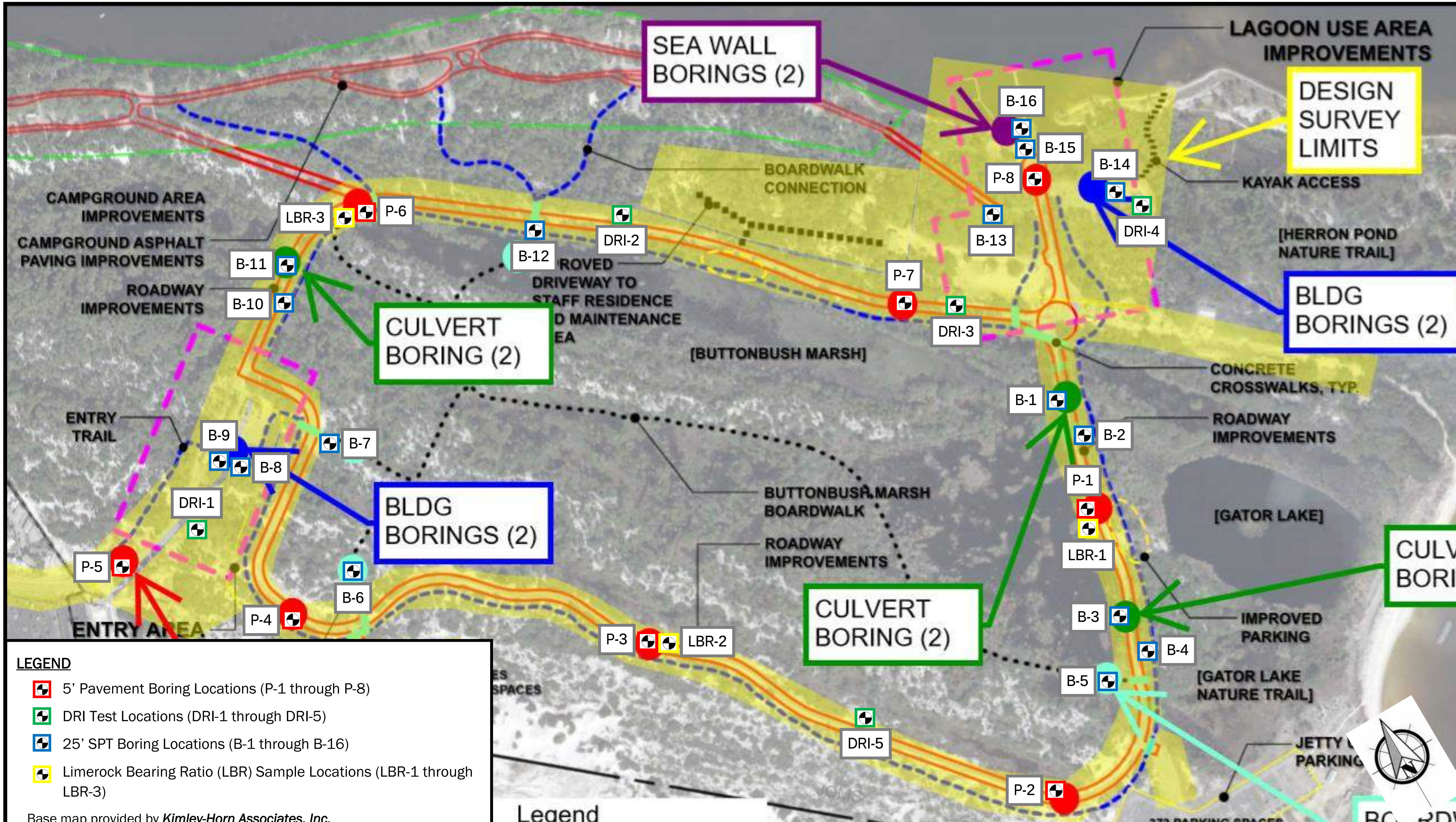
Date(s) aerial images were photographed: Jan 1, 1999—Mar 7, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
31	Osier fine sand	77.2	11.8%
43	Urban land	31.8	4.8%
44	Beaches	48.3	7.4%
48	Fripp-Corolla complex, 2 to 30 percent slopes	224.6	34.2%
52	Bayvi loamy sand	118.9	18.1%
99	Water	124.1	18.9%
Totals for Area of Interest		**655.7**	**100.0%**

APPENDIX B
Subsurface Data



Scale: Not To Scale
Date Drawn: March 19, 2020
Drawn By: D. Ritzel
Checked By: A. Kniazeff

NOVA
17612 Ashley Drive
Panama City Beach, Florida 32413
850.249.NOVA(6682) ♦ 850.249.6683

BORING LOCATION PLAN
St. Andrews State Park Improvements
Panama City Beach, Bay County, Florida
NOVA Project Number 10111-2020028

KEY TO BORING LOGS

SYMBOLS AND ABBREVIATIONS

SYMBOL	DESCRIPTION
N-Value	No. of Blows of a 140-lb. Weight Falling 30 Inches Required to Drive a Standard Spoon 1 Foot
WOR	Weight of Drill Rods
WOH	Weight of Drill Rods and Hammer
	Sample from Auger Cuttings
	Standard Penetration Test Sample
	Thin-wall Shelby Tube Sample (Undisturbed Sampler Used)
% REC	Percent Core Recovery from Rock Core Drilling
RQD	Rock Quality Designation
	Stabilized Groundwater Level
	Seasonal High Groundwater Level (also referred to as the W.S.W.T.)
NE	Not Encountered
GNE	Groundwater Not Encountered
BT	Boring Terminated
-200 (%)	Fines Content or % Passing No. 200 Sieve
MC (%)	Moisture Content
LL	Liquid Limit (Atterberg Limits Test)
PI	Plasticity Index (Atterberg Limits Test)
K	Coefficient of Permeability
Org. Cont.	Organic Content
G.S. Elevation	Ground Surface Elevation

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on the the No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS 5% or less passing No. 200 sieve	SW**	Well-graded sands and gravelly sands, little or no fines
			SP**	Poorly graded sands and gravelly sands, little or no fines
		SANDS with 12% or more passing No. 200 sieve	SM**	Silty sands, sand-silt mixtures
			SC**	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diamicaceous fine sands or silts, elastic silts
			CH	Inorganic clays or clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
			PT	Peat, muck and other highly organic soils

*Based on the material passing the 3-inch (75 mm) sieve
** Use dual symbol (such as SP-SM and SP-SC) for soils with more than 5% but less than 12% passing the No. 200 sieve

RELATIVE DENSITY
(Sands and Gravels)
Very loose – Less than 4 Blow/Foot
Loose – 4 to 10 Blows/Foot
Medium Dense – 11 to 30 Blows/Foot
Dense – 31 to 50 Blows/Foot
Very Dense – More than 50 Blows/Foot

CONSISTENCY
(Silts and Clays)
Very Soft – Less than 2 Blows/Foot
Soft – 2 to 4 Blows/Foot
Medium Stiff – 5 to 8 Blows/Foot
Stiff – 9 to 15 Blows/Foot
Very Stiff – 16 to 30 Blows/Foot
Hard – More than 30 Blows/Foot

RELATIVE HARDNESS
(Limestone)
Soft – 100 Blows for more than 2 Inches
Hard – 100 Blows for less than 2 Inches

MODIFIERS

These modifiers Provide Our Estimate of the Amount of Minor Constituents (Silt or Clay Size Particles) in the Soil Sample
Trace – 5% or less
With Silt or With Clay – 6% to 11%
Silty or Clayey – 12% to 30%
Very Silty or Very Clayey – 31% to 50%

These Modifiers Provide Our Estimate of the Amount of Organic Components in the Soil Sample
Trace – Less than 3%
Few – 3% to 4%
Some – 5% to 8%
Many – Greater than 8%

These Modifiers Provide Our Estimate of the Amount of Other Components (Shell, Gravel, Etc.) in the Soil Sample
Trace – 5% or less
Few – 6% to 12%
Some – 13% to 30%
Many – 31% to 50%

NOVA

TEST BORING RECORD B-1

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 3.0 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0–23.5		Loose to dense light brown to light grey to brown fine-grained SAND (SP)		▼ (3.0 ft)		6, 8, 11, 12, 12, 32, 40
23.5–25		Dark grey slightly silty fine-grained SAND with few organics - organic silt (SP-SM)				15
25		Boring Terminated at 25 feet				

Depth scale: 0, 5, 10, 15, 20, 25

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-2

PROJECT NAME:	St. Andrews State Park Improvements
PROJECT NO.:	2020028
CLIENT:	Kimley-Horn & Associates, Inc.
PROJECT LOCATION:	Panama City Beach, Bay County, Florida
LOCATION:	See Boring Location Plan
ELEVATION:	Existing Grade
DRILLED BY:	L. Griffin
LOGGED BY:	K. Selle
DRILLING METHOD:	Mud Rotary
DATE:	3/18/2020
INITIAL GW DEPTH: ▼	2.5 feet
ESHGW DEPTH: ▽	

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL ├──┤ LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0–25		Loose to very dense light grey to light brown fine-grained SAND (SP)				
1						4
2.5				▼		
3						6
5						10
7						14
9						18
14.5						36
19.5						52
24.5						32
25		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-3

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: 2.5 feet ESHGW DEPTH:

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose to very dense light grey to brown fine-grained SAND (SP)				
						10
				▼		12
5						12
						16
						19
10						
15						32
20						66
25						77
		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

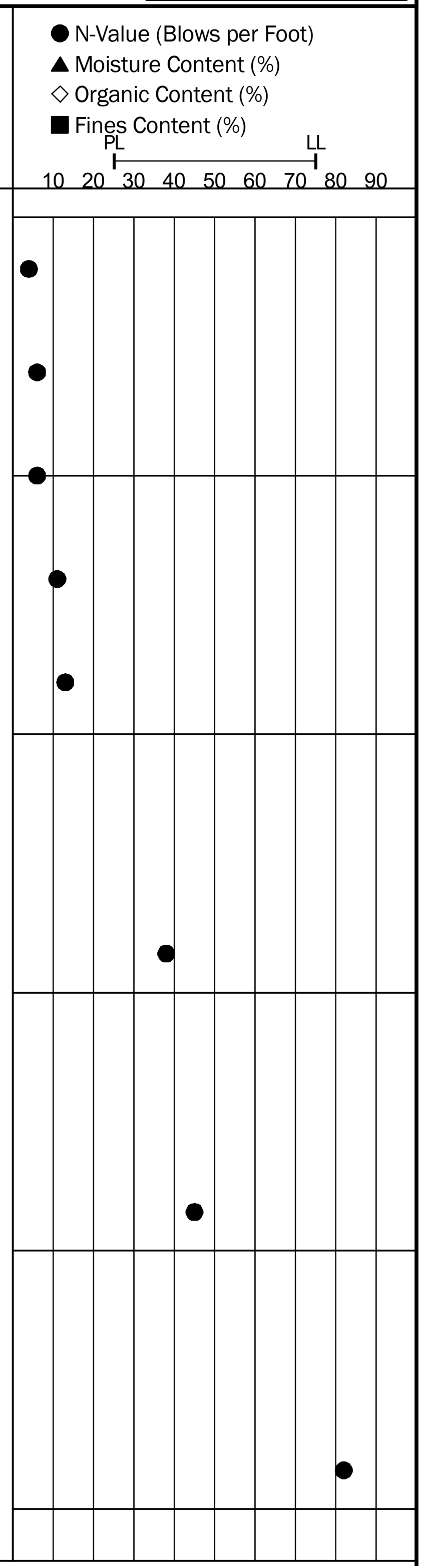
Note:

NOVA

TEST BORING RECORD B-4

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: 2.5 feet ESHGW DEPTH:

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0–25		Loose to very dense light grey/light brown to light grey fine-grained SAND (SP)		▼ (2.5 ft)		
1						4
3						6
5						6
7						11
9						13
14.5						38
19.5						45
24.5						82
25		Boring Terminated at 25 feet				



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-5

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 0.4 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose to very dense light grey to light brown fine-grained SAND (SP)		▼		
1						4
3						13
5						18
7						24
9						30
14.5						46
19.5						32
24.5						77
25		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-6

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: L. Griffin	LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary	DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 3.3 feet	ESHGW DEPTH: ▽

Legend: ● N-Value (Blows per Foot); ▲ Moisture Content (%); ◇ Organic Content (%); ■ Fines Content (%); PL, LL

Scale: 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
		Very loose to very dense light grey to light brown fine-grained SAND (SP)				2
				▼		7
5						11
						11
						13
10						
15						47
20						56
25						86
		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-7

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 4.0 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose to very dense light grey to light grey/light brown fine-grained SAND (SP)				
1						4
3						11
4				▼		
5						14
7						15
9						18
10						
14.5						50
15						
19.5						66
20						
24.5						52
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA TEST BORING RECORD B-8	
PROJECT NAME:	St. Andrews State Park Improvements
PROJECT NO.:	2020028
CLIENT:	Kimley-Horn & Associates, Inc.
PROJECT LOCATION:	Panama City Beach, Bay County, Florida
LOCATION:	See Boring Location Plan
ELEVATION:	Existing Grade
DRILLED BY:	L. Griffin
LOGGED BY:	K. Selle
DRILLING METHOD:	Mud Rotary
DATE:	3/19/2020
INITIAL GW DEPTH:	4.0 feet
ESHGW DEPTH:	

Legend: ● N-Value (Blows per Foot); ▲ Moisture Content (%); ◇ Organic Content (%); ■ Fines Content (%); PL, LL; scale 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose to very dense grey/light grey to light grey fine-grained SAND (SP)				
1–2						7
3–4				▼ (4.0 ft)		11
5–6						14
7–8						15
9–10						22
14						54
19						72
24						66
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD B-9

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 4.0 feet ESHGW DEPTH: ▽

Legend: ● N-Value (Blows per Foot) ▲ Moisture Content (%) ◇ Organic Content (%) ■ Fines Content (%) PL LL
Scale: 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0 – 25		Medium dense to very dense light grey fine-grained SAND (SP)		▼ (4.0)		
0 – 2						16
2 – 4						14
4 – 6						13
6 – 8						13
8 – 10						13
13.5 – 15						36
18.5 – 20						39
23.5 – 25						66
25		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-10

PROJECT NAME:	St. Andrews State Park Improvements
PROJECT NO.:	2020028
CLIENT:	Kimley-Horn & Associates, Inc.
PROJECT LOCATION:	Panama City Beach, Bay County, Florida
LOCATION:	See Boring Location Plan
ELEVATION:	Existing Grade
DRILLED BY:	L. Griffin
LOGGED BY:	K. Selle
DRILLING METHOD:	Mud Rotary
DATE:	3/18/2020
INITIAL GW DEPTH:	4.0 feet
ESHGW DEPTH:	

Legend: ● N-Value (Blows per Foot); ▲ Moisture Content (%); ◇ Organic Content (%); ■ Fines Content (%); PL – LL; scale 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose to dense light grey fine-grained SAND (SP)				
1					SPT	7
3					SPT	9
4				▼		
5					SPT	11
7					SPT	18
9					SPT	24
14					SPT	48
19					SPT	44
24					SPT	26
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD B-11

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 4.0 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
		Loose light grey/light brown slightly silty fine-grained SAND (SP-SM)				8
		Loose to very dense light grey fine-grained SAND (SP)				9
				▼		
5						6
						13
						16
10						
15						47
20						32
25						62
		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD B-12

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 2.5 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0.5–18.5		Loose to medium dense light grey fine-grained SAND (SP)		▼ (2.5 ft)		
1						10
3						12
5						17
7						21
9						24
14						24
18.5–25		Medium dense grey to dark grey slightly silty fine-grained SAND (SP-SM)				
19						24
24						24
25		Boring Terminated at 25 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD B-13

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 7.0 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0.5–13.5		Loose to medium dense light grey fine-grained SAND (SP)		▼ (7.0)		5, 6, 7, 10, 11
13.5–18.5		Loose dark brown fine-grained SAND with trace organics - organic silt (SP)				10
18.5–25		Loose to medium dense grey/brown to brown slightly silty fine-grained SAND (SP-SM)				18, 10
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD B-14

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: L. Griffin LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 3.8 feet ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
0–2		Loose dark grey slightly silty fine-grained SAND with trace organics - organic silt (SP-SM)				7
2–25		Loose to medium dense light grey to brown fine-grained SAND (SP)		▼ (3.8 ft)		12, 13, 12, 13, 13, 10, 22
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD B-15

NOVA

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: L. Griffin	LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary	DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 4.3 feet	ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Loose brown/orange silty fine-grained SAND (SM)				6
		Loose light brown/orange slightly silty fine-grained SAND (SP-SM)				8
5		Medium dense light grey to brown fine-grained SAND (SP)		▼		13
						13
						15
10						
15						12
		Medium dense brown slightly silty fine-grained SAND (SP-SM)				13
20						
		Loose light grey fine-grained SAND (SP)				8
25		Boring Terminated at 25 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD B-16

NOVA

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: L. Griffin	LOGGED BY: K. Selle
DRILLING METHOD: Mud Rotary	DATE: 3/18/2020
INITIAL GW DEPTH: ▼ 4.0 feet	ESHGW DEPTH: ▽

Legend: ● N-Value (Blows per Foot); ▲ Moisture Content (%); ◇ Organic Content (%); ■ Fines Content (%); PL |—| LL; scale 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Groundwater	N-Value
0		Loose brown/orange silty fine-grained SAND (SM)		8
		Loose to medium dense light grey to dark grey fine-grained SAND (SP)		11
			▼	
5				4
		Loose dark brown fine-grained SAND with few organics - organic silt (SP)		5
		Loose to medium dense grey to brown slightly silty fine-grained SAND (SP-SM)		8
10				
15				7
20				12
		Medium dense light grey fine-grained SAND (SP)		14
25		Boring Terminated at 25 feet		

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD P-1

NOVA

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: D. Ritzel	LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger	DATE: 3/18/2020
APPARENT GW DEPTH: ▼ 4.2 feet	ESHGW DEPTH: ▽ 2.7 feet

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
		Brown slightly silty fine-grained SAND (SP-SM)				
		Light grey to grey fine-grained SAND (SP)		▽ ▼		
5						
		Boring Terminated at 5 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA TEST BORING RECORD P-2	PROJECT NAME: St. Andrews State Park Improvements PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc. PROJECT LOCATION: Panama City Beach, Bay County, Florida LOCATION: See Boring Location Plan ELEVATION: Existing Grade DRILLED BY: D. Ritzel LOGGED BY: K. Selle DRILLING METHOD: Hand Auger DATE: 3/20/2020 INITIAL GW DEPTH: ▼ GNE ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0						
		Brown/grey slightly silty fine-grained SAND with shell (SP-SM)				
		Light grey fine-grained SAND (SP)				
5						
		Boring Terminated at 5 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD P-3

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: D. Ritzel	LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger	DATE: 3/18/2020
INITIAL GW DEPTH: ▼ GNE	ESHGW DEPTH: ▽

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value	● N-Value (Blows per Foot) ▲ Moisture Content (%) ◇ Organic Content (%) ■ Fines Content (%) PL LL 10 20 30 40 50 60 70 80 90
0							
		Grey/brown slightly silty fine-grained SAND (SP-SM)					
		Brown/orange very silty fine-grained SAND (SM)					▲ ■
		Light grey fine-grained SAND (SP)					
5		Boring Terminated at 5 feet					

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD P-4

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: D. Ritzel	LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger	DATE: 3/20/2020
INITIAL GW DEPTH: ▼ GNE	ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Light grey/brown slightly silty fine-grained SAND (SP-SM)				
		Light grey fine-grained SAND (SP)				
5		Boring Terminated at 5 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD P-5

NOVA

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: D. Ritzel	LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger	DATE: 3/20/2020
INITIAL GW DEPTH: ▼ GNE	ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Brown slightly silty fine-grained SAND (SP-SM)				
		Brown/orange silty fine-grained SAND with shell (SP-SM)				
		Light brown to light grey fine-grained SAND (SP)				
5		Boring Terminated at 5 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD P-6

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028   CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan   ELEVATION: Existing Grade
DRILLED BY: D. Ritzel   LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger   DATE: 3/18/2020
APPARENT GW DEPTH: ▼ 4.4 feet   ESHGW DEPTH: ▽ 2.7 feet

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Grey slightly silty fine-grained SAND (SP-SM)				
		Brown/orange silty fine-grained SAND (SM)				
		Light grey fine-grained SAND (SP)		▽		
		Dark grey fine-grained SAND with trace organics - organic silt (SP)				
		Grey/light grey fine-grained SAND (SP)		▼		
5		Boring Terminated at 5 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD P-7

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: D. Ritzel LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger DATE: 3/20/2020
INITIAL GW DEPTH: ▼ GNE ESHGW DEPTH: ▽

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Brown/grey slightly silty fine-grained SAND (SP-SM)				
		Grey/dark grey fine-grained SAND with trace organics - organic silt (SP)				
		Light grey fine-grained SAND (SP)				
5		Boring Terminated at 5 feet				

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD P-8

PROJECT NAME:	St. Andrews State Park Improvements
PROJECT NO.:	2020028
CLIENT:	Kimley-Horn & Associates, Inc.
PROJECT LOCATION:	Panama City Beach, Bay County, Florida
LOCATION:	See Boring Location Plan
ELEVATION:	Existing Grade
DRILLED BY:	D. Ritzel
LOGGED BY:	K. Selle
DRILLING METHOD:	Hand Auger
DATE:	3/24/2020
APPARENT GW DEPTH ▼	3.8 feet
ESHGW DEPTH ▽	2.3 feet

Legend: ● N-Value (Blows per Foot); ▲ Moisture Content (%); ◇ Organic Content (%); ■ Fines Content (%); PL — LL; scale 10 20 30 40 50 60 70 80 90

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Approximately 3 inches of Cementitious Concrete				
		Approximately 5 inches of Asphaltic Concrete				
		Brown/orange silty fine-grained SAND (SM)				
		Light grey fine-grained SAND (SP)		▽ ▼		
5		Boring Terminated at 5 feet				

Note:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

NOVA

TEST BORING RECORD DRI-1

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: D. Ritzel LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger DATE: 3/20/2020
APPARENT GW DEPTH: 4.9 feet ESHGW DEPTH: 3.4 feet

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value	● N-Value (Blows per Foot) ▲ Moisture Content (%) ◇ Organic Content (%) ■ Fines Content (%) PL–LL 10 20 30 40 50 60 70 80 90
0		Grey slightly silty fine-grained SAND with trace organics - organic silt (SP-SM)					
		Light grey fine-grained SAND (SP)		▽ (3.4 ft) ▼ (4.9 ft)			
5							
		Boring Terminated at 7 feet					
10							

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

TEST BORING RECORD DRI-2

NOVA

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: D. Ritzel LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger DATE: 3/23/2020
APPARENT GW DEPTH: 5.4 feet ESHGW DEPTH: 3.9 feet

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value	● N-Value (Blows per Foot) ▲ Moisture Content (%) ◇ Organic Content (%) ■ Fines Content (%) PL–LL 10 20 30 40 50 60 70 80 90
0		Light brown to light grey fine-grained SAND (SP)					
5				ESHGW 3.9 ft; GW 5.4 ft			
		Boring Terminated at 8.5 feet					
10							

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

TEST BORING RECORD DRI-3

NOVA

PROJECT NAME:	St. Andrews State Park Improvements
PROJECT NO.:	2020028
CLIENT:	Kimley-Horn & Associates, Inc.
PROJECT LOCATION:	Panama City Beach, Bay County, Florida
LOCATION:	See Boring Location Plan
ELEVATION:	Existing Grade
DRILLED BY:	D. Ritzel
LOGGED BY:	K. Selle
DRILLING METHOD:	Hand Auger
DATE:	3/20/2020
APPARENT GW DEPTH: ▼	3.3 feet
ESHGW DEPTH: ▽	1.8 feet

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0 – 5.5		Light brown to light grey fine-grained SAND (SP)		▽ 1.8, ▼ 3.3		
5.5		Boring Terminated at 5.5 feet				

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL — LL

10 20 30 40 50 60 70 80 90

Depth scale: 0, 5, 10

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD DRI-4

PROJECT NAME: St. Andrews State Park Improvements
PROJECT NO.: 2020028 CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida
LOCATION: See Boring Location Plan ELEVATION: Existing Grade
DRILLED BY: D. Ritzel LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger DATE: 3/20/2020
APPARENT GW DEPTH: ▼ 3.0 feet ESHGW DEPTH: ▽ 1.5 feet

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value
0		Light grey/grey to light grey fine-grained SAND (SP)		▽ (1.5 ft); ▼ (3.0 ft)		
5		Boring Terminated at 5 feet				
10						

● N-Value (Blows per Foot)
▲ Moisture Content (%)
◇ Organic Content (%)
■ Fines Content (%)
PL LL
10 20 30 40 50 60 70 80 90

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Note:

NOVA

TEST BORING RECORD DRI-5

PROJECT NAME: St. Andrews State Park Improvements	
PROJECT NO.: 2020028	CLIENT: Kimley-Horn & Associates, Inc.
PROJECT LOCATION: Panama City Beach, Bay County, Florida	
LOCATION: See Boring Location Plan	ELEVATION: Existing Grade
DRILLED BY: D. Ritzel	LOGGED BY: K. Selle
DRILLING METHOD: Hand Auger	DATE: 3/23/2020
APPARENT GW DEPTH: ▼ 9.0 feet	ESHGW DEPTH: ▽ 7.5 feet

Depth (feet)	Elevation	Material Description	Graphic	Groundwater	Sample Type	N-Value	● N-Value (Blows per Foot) ▲ Moisture Content (%) ◇ Organic Content (%) ■ Fines Content (%) PL LL 10 20 30 40 50 60 70 80 90
0		Light grey/grey to light grey fine-grained SAND (SP)					
5							
				▽			
				▼			
10		Boring Terminated at 10 feet					

Note:

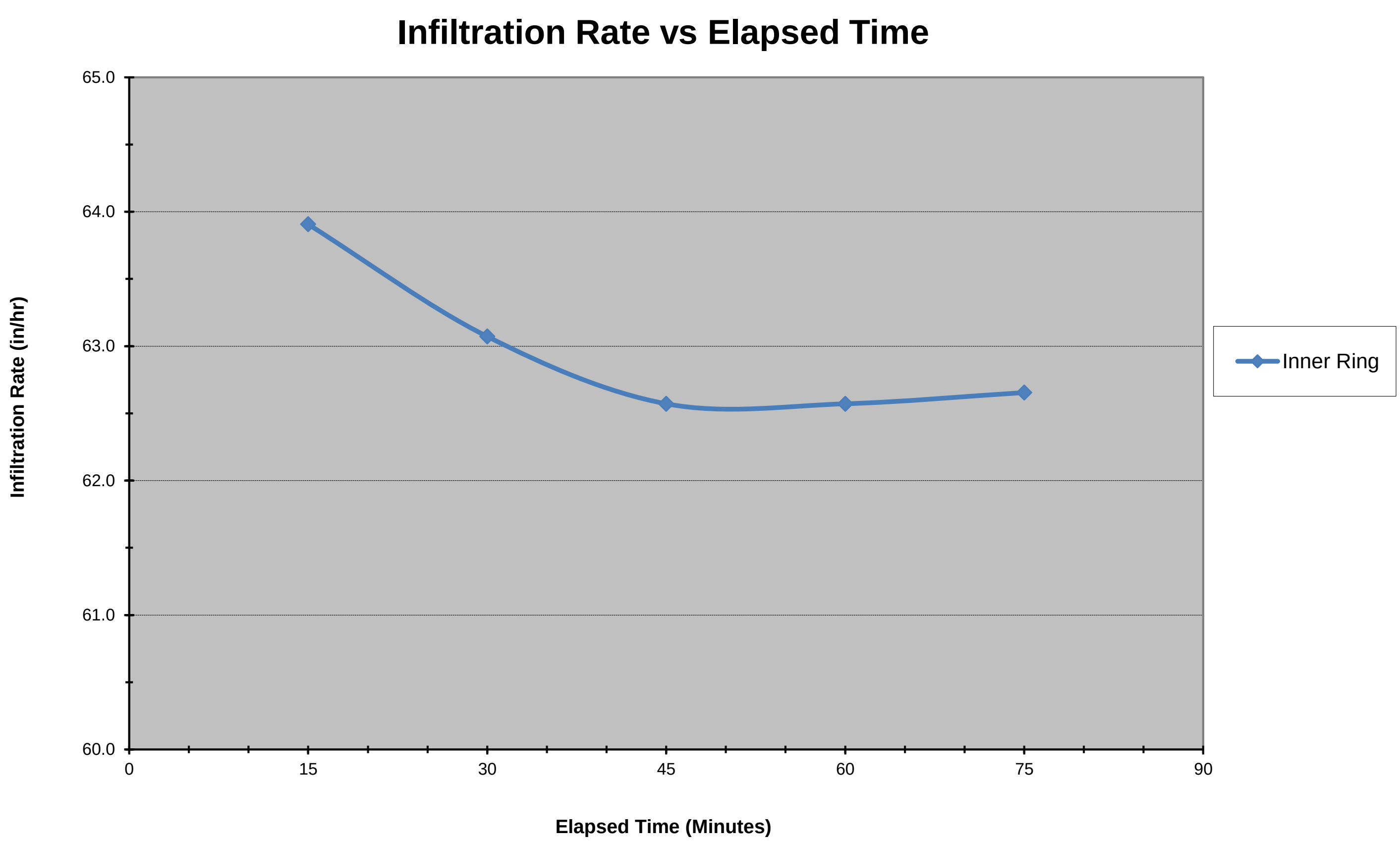
This information pertains only to this boring and should not be interpreted as being indicative of the site.

Project:	St. Andrews State Park Improvements	Report of DRI-1
Project Location:	Panama City Beach, Bay County, Florida	
Project Number:	10111-2020028	

Date(s) of Test	**March 19, 2020**	Logged by	**K. Selle**	Checked by	**A. Kniazeff**
Test Method	**ASTM D 3385**	Weather	**Sunny**	Type of liquid	**Municipal Water**
Area Inner Ring	**110.75 sq. in.**	Technician(s)	**D. Ritzel , K. Selle**	Liquid Temperature	**Ambient**
Area Outer Ring	**447.69 sq. in.**	See Attached Auger Boring Record for Soil Profile		Soil Temperature	**Ambient**
Area Annular Space	**334.59 sq. in.**	Approx. Elev. / Location	**2.0' Below Grade/ See Boring Location Plan**		

INCREMENTAL INFILTRATION RATE vs. TOTAL ELAPSED TIME

		Inner Ring		Annular Ring		
Time	Elapsed Time (minutes)	Volume (Gal)	Infiltration Rate (In/hr)	Volume (Gal)	Infiltration Rate (In/hr)	Comments
1:46:00 PM	0	---	---	---	---	Infiltration data collected after 30 minute saturation period.
2:46:00 PM	15	7.66	63.9	25.480	70.365	
3:46:00 PM	30	7.56	63.1	24.120	66.609	
4:46:00 PM	45	7.50	62.6	23.530	64.980	
5:46:00 PM	60	7.50	62.6	23.250	64.207	
6:46:00 PM	75	7.51	62.7	23.110	63.820	



NOVA ENGINEERING AND ENVIRONMENTAL

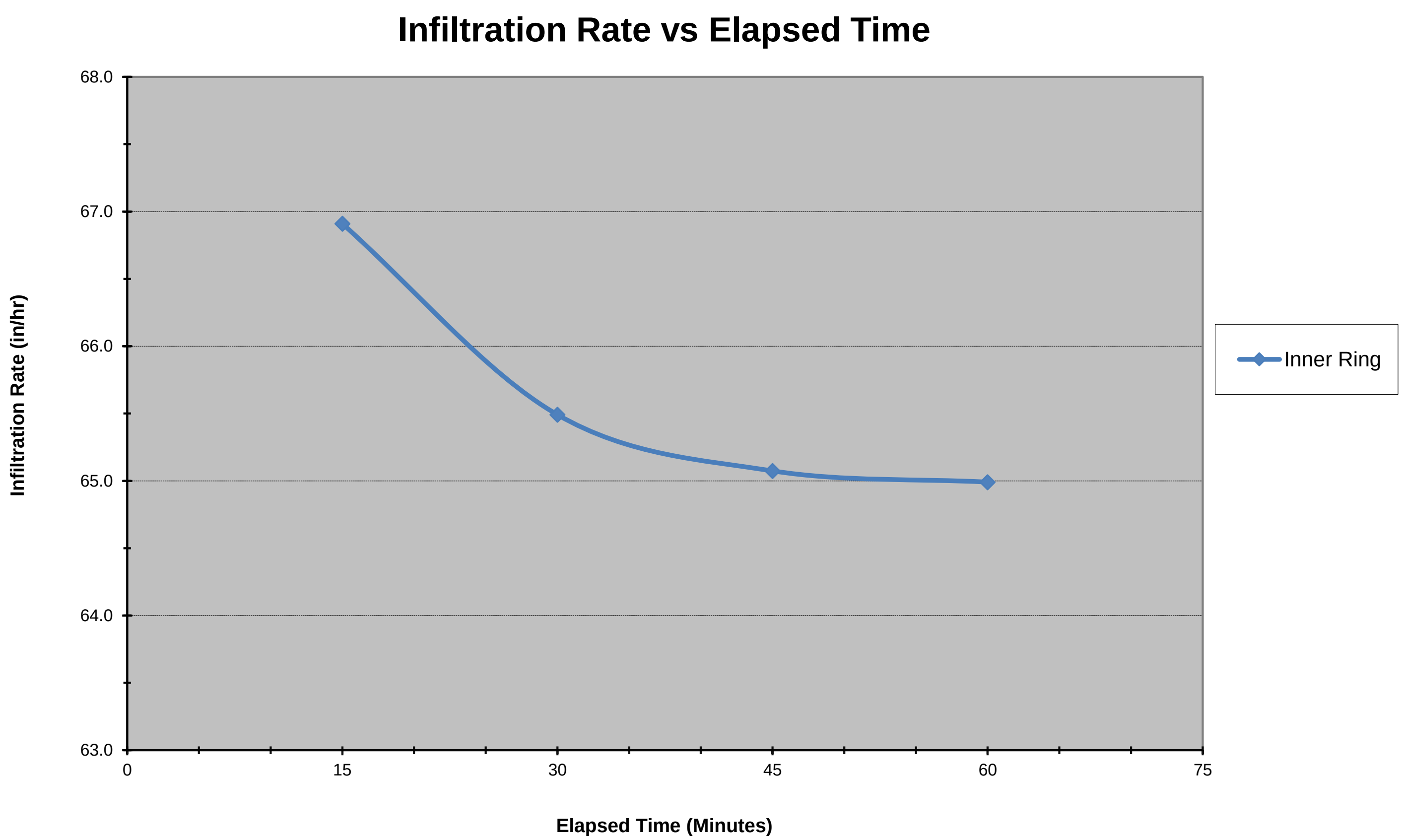
Infiltration Rate: 62.6 Inches Per Hour

Project:	**St. Andrews State Park Improvements**	**Report of DRI-2**
Project Location:	**Panama City Beach, Bay County, Florida**	
Project Number:	**10111-2020028**	

Date(s) of Test	**March 23, 2020**	Logged by	**D. Ritzel**	Checked by	**A. Kniazeff**
Test Method	**ASTM D 3385**	Weather	**Sunny**	Type of liquid	**Municipal Water**
Area Inner Ring	**110.75 sq. in.**	Technician(s)	**D. Ritzel , K. Selle**	Liquid Temperature	**Ambient**
Area Outer Ring	**447.69 sq. in.**	See Attached Auger Boring Record for Soil Profile		Soil Temperature	**Ambient**
Area Annular Space	**334.59 sq. in.**	Approx. Elev. / Location	**2.0' Below Grade/ See Boring Location Plan**		

INCREMENTAL INFILTRATION RATE vs. TOTAL ELAPSED TIME

		Inner Ring		Annular Ring		
Time	**Elapsed Time (minutes)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Comments**
12:36:00 PM	0	---	---	---	---	Infiltration data collected after 30 minute saturation period.
12:51:00 PM	15	8.02	66.9	25.406	70.161	
1:06:00 PM	30	7.85	65.5	25.264	69.768	
1:21:00 PM	45	7.80	65.1	24.912	68.796	
1:36:00 PM	60	7.79	65.0	24.881	68.711	



NOVA ENGINEERING AND ENVIRONMENTAL

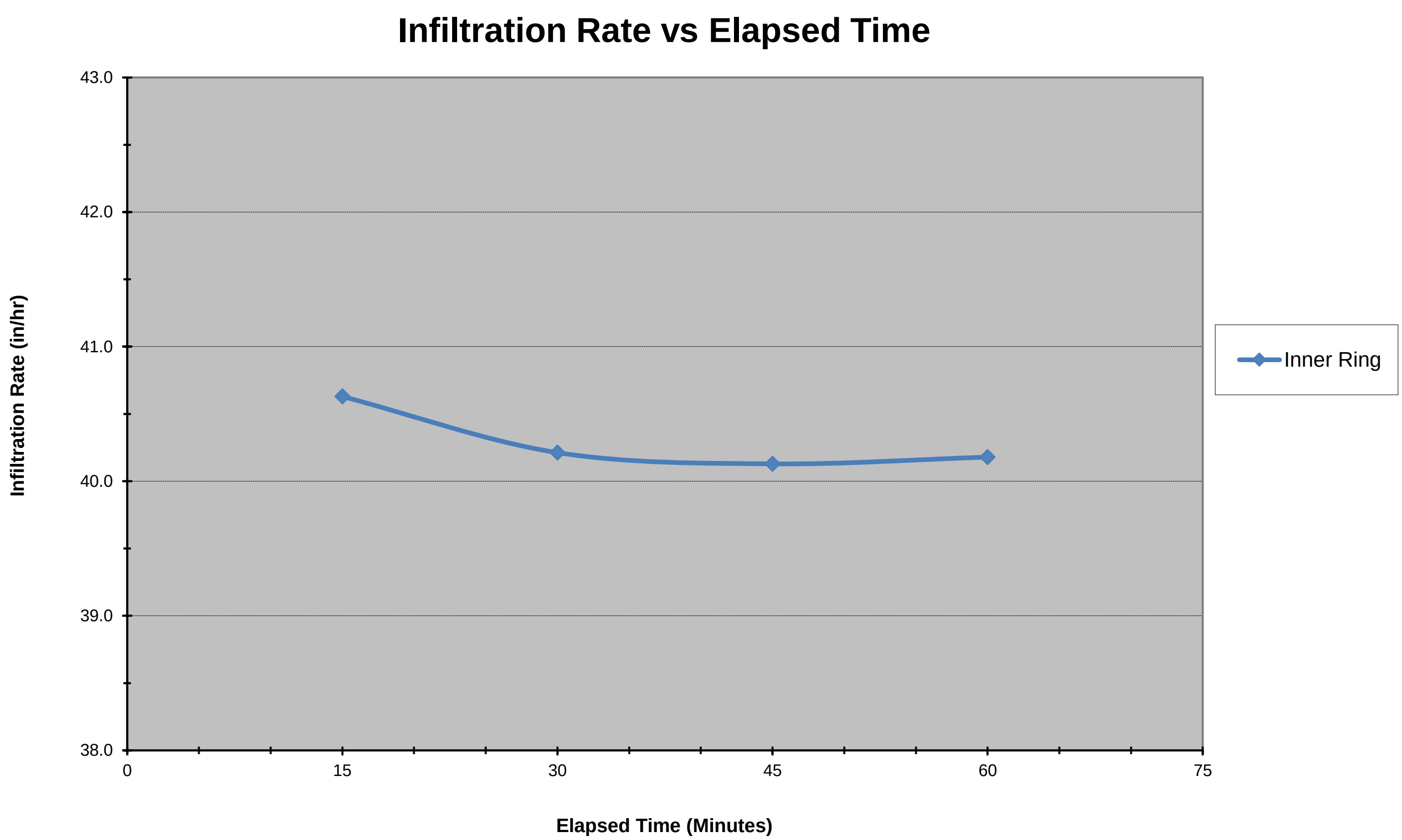
Infiltration Rate: 65.0 Inches Per Hour

Project:	**St. Andrews State Park Improvements**	**Report of DRI-3**
Project Location:	**Panama City Beach, Bay County, Florida**	
Project Number:	**10111-2020028**	

Date(s) of Test	**March 20, 2020**	Logged by	**D. Ritzel**	Checked by	**A. Kniazeff**
Test Method	**ASTM D 3385**	Weather	**Sunny**	Type of liquid	**Municipal Water**
Area Inner Ring	**110.75 sq. in.**	Technician(s)	**D. Ritzel , K. Selle**	Liquid Temperature	**Ambient**
Area Outer Ring	**447.69 sq. in.**	See Attached Auger Boring Record for Soil Profile		Soil Temperature	**Ambient**
Area Annular Space	**334.59 sq. in.**	Approx. Elev. / Location	**2.0' Below Grade/ See Boring Location Plan**		

INCREMENTAL INFILTRATION RATE vs. TOTAL ELAPSED TIME

		Inner Ring		Annular Ring		
Time	**Elapsed Time (minutes)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Comments**
1:20:00 PM	0	---	---	---	---	Infiltration data collected after 30 minute saturation period.
1:35:00 PM	15	4.87	40.6	18.351	50.678	
1:50:00 PM	30	4.82	40.2	18.115	50.026	
2:05:00 PM	45	4.81	40.1	17.898	49.427	
2:20:00 PM	60	4.82	40.2	17.876	49.366	



NOVA ENGINEERING AND ENVIRONMENTAL

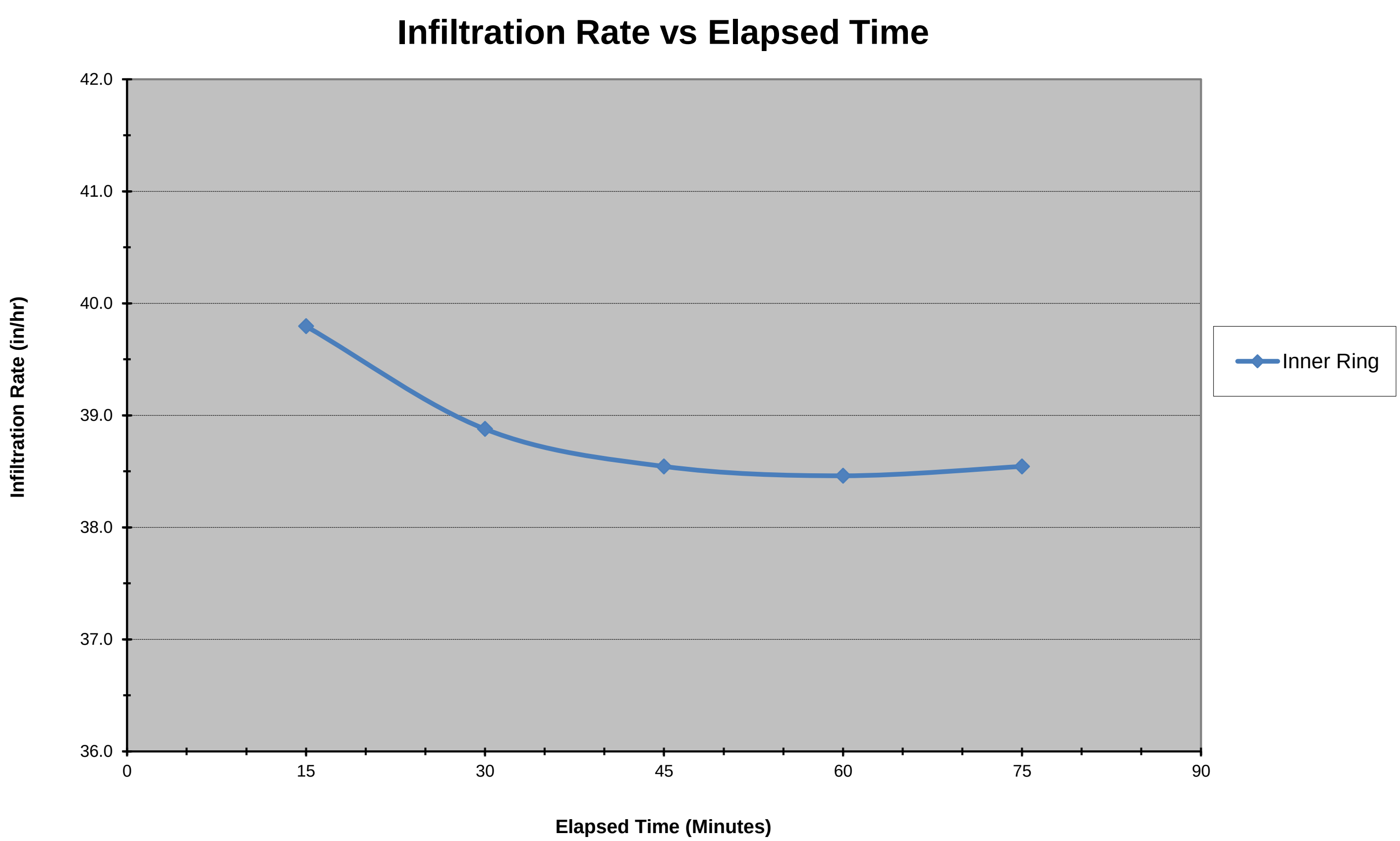
Infiltration Rate: 40.1 Inches Per Hour

Project:	**St. Andrews State Park Improvements**	**Report of DRI-4**
Project Location:	**Panama City Beach, Bay County, Florida**	
Project Number:	**10111-2020028**	

Date(s) of Test	**March 20, 2020**	Logged by	**D. Ritzel**	Checked by	**A. Kniazeff**
Test Method	**ASTM D 3385**	Weather	**Sunny**	Type of liquid	**Municipal Water**
Area Inner Ring	**110.75 sq. in.**	Technician(s)	**D. Ritzel , K. Selle**	Liquid Temperature	**Ambient**
Area Outer Ring	**447.69 sq. in.**	See Attached Auger Boring Record for Soil Profile		Soil Temperature	**Ambient**
Area Annular Space	**334.59 sq. in.**	Approx. Elev. / Location	**2.0' Below Grade/ See Boring Location Plan**		

INCREMENTAL INFILTRATION RATE vs. TOTAL ELAPSED TIME

		Inner Ring		Annular Ring		
Time	**Elapsed Time (minutes)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Comments**
10:40:00 AM	0	---	---	---	---	Infiltration data collected after 30 minute saturation period.
10:55:00 AM	15	4.77	39.8	16.450	45.428	
11:10:00 AM	30	4.66	38.9	16.217	44.784	
11:25:00 AM	45	4.62	38.5	15.981	44.133	
11:40:00 AM	60	4.61	38.5	15.773	43.558	
11:55:00 AM	75	4.62	38.5	15.629	43.161	



NOVA ENGINEERING AND ENVIRONMENTAL

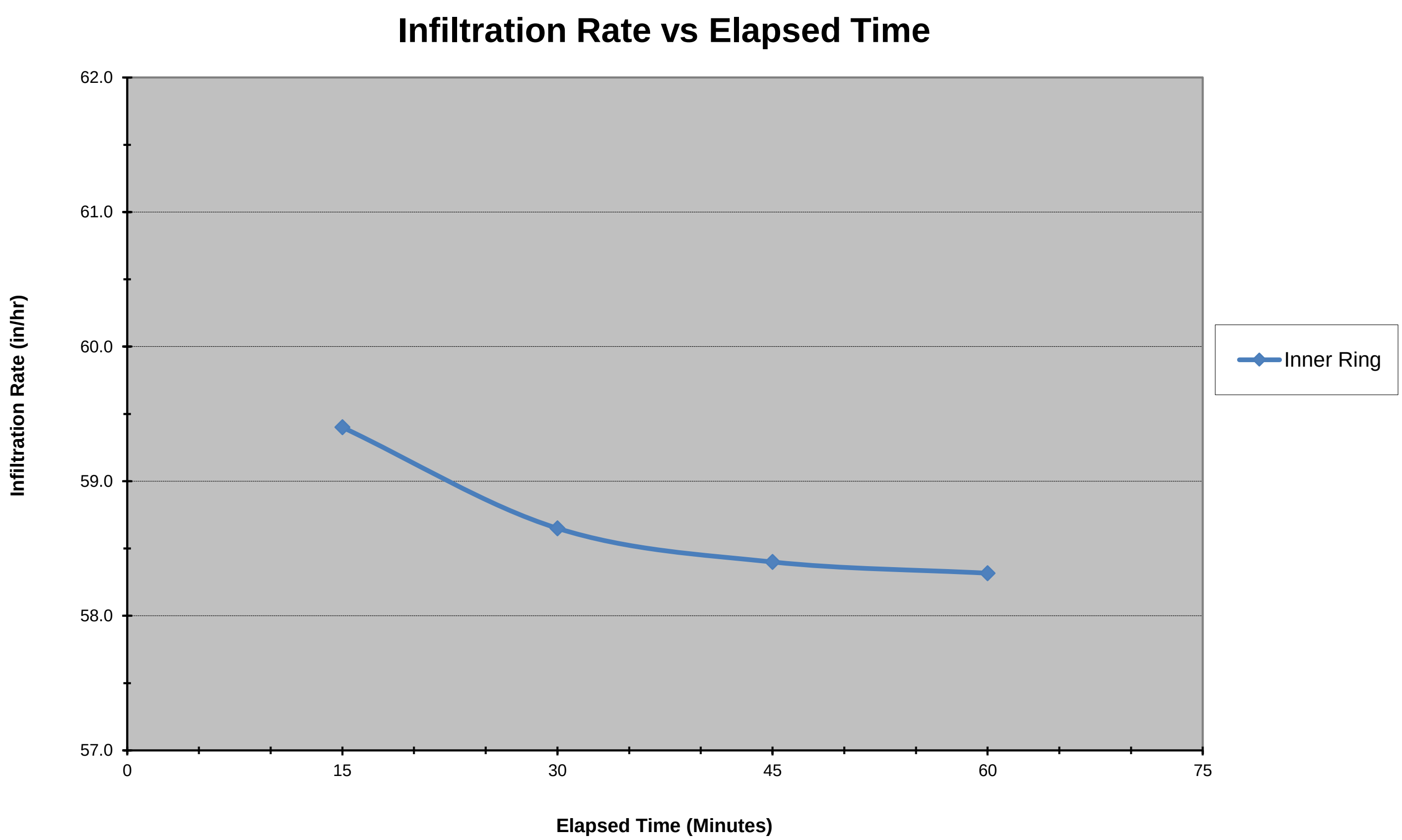
Infiltration Rate: 38.5 Inches Per Hour

Project:	**St. Andrews State Park Improvements**	**Report of DRI-5**
Project Location:	**Panama City Beach, Bay County, Florida**	
Project Number:	**10111-2020028**	

Date(s) of Test	**March 23, 2020**	Logged by	**D. Ritzel**	Checked by	**A. Kniazeff**
Test Method	**ASTM D 3385**	Weather	**Sunny**	Type of liquid	**Municipal Water**
Area Inner Ring	**110.75 sq. in.**	Technician(s)	**D. Ritzel , K. Selle**	Liquid Temperature	**Ambient**
Area Outer Ring	**447.69 sq. in.**	See Attached Auger Boring Record for Soil Profile		Soil Temperature	**Ambient**
Area Annular Space	**334.59 sq. in.**	Approx. Elev. / Location	**2.0' Below Grade/ See Boring Location Plan**		

INCREMENTAL INFILTRATION RATE vs. TOTAL ELAPSED TIME

		Inner Ring		Annular Ring		
Time	**Elapsed Time (minutes)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Volume (Gal)**	**Infiltration Rate (In/hr)**	**Comments**
10:12:00 AM	0	---	---	---	---	Infiltration data collected after 30 minute saturation period.
10:27:00 AM	15	7.12	59.4	24.511	67.689	
10:42:00 AM	30	7.03	58.7	24.219	66.883	
10:47:00 AM	45	7.00	58.4	23.948	66.134	
10:52:00 AM	60	6.99	58.3	23.875	65.933	



Infiltration Rate: 58.3 Inches Per Hour

St. Andrews State Park P-1 - General Roadway Conditions

St. Andrews State Park P-2 - General Roadway Conditions

St. Andrews State Park P-3 - General Roadway Conditions

St. Andrews State Park P-4 - General Roadway Conditions

St. Andrews State Park P-6 - General Roadway Conditions

St. Andrews State Park P-7 - General Roadway Conditions

St. Andrews State Park P-8 - General Roadway Conditions

Core P-8 - Approximately 3¼ Inches of Cementitious Concrete & 5 Inches of Asphaltic Concrete

APPENDIX C
Laboratory Data

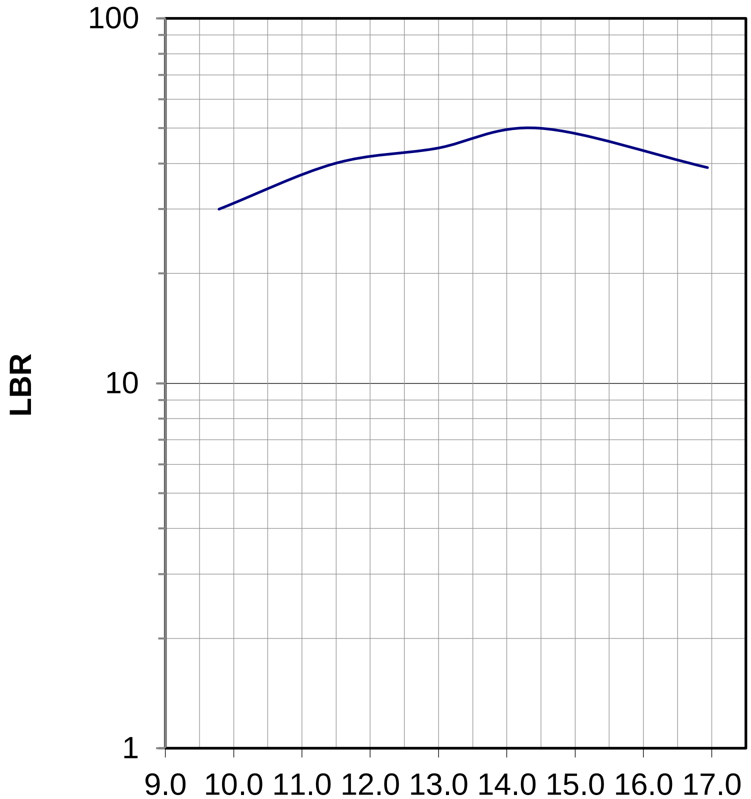
SUMMARY OF CLASSIFICATION & INDEX TESTING

St. Andrews State Park Improvements
Panama City Beach, Bay County, Florida
NOVA Project Number 10111-2020028

Boring Number	Sample Depth (ft)	Natural Moisture (%)	Percent (%) Passing Sieve #200	Organic Content (%)	USCS Soil Classification
B-8	0.0 – 2.0	4	0.8	—	SP
B-13	13.5 – 15.0	21	4.6	—	SP
B-14	0.0 – 2.0	7	5.1	—	SP-SM
B-15	0.0 – 2.0	12	23.1	—	SM
B-16	6.0 – 8.0	25	3.7	3.5	SP
P-3	0.25 – 0.5	10	34.1	—	SM
P-5	0.5 – 1.0	5	10.3	—	SP-SM
P-6	0.5 – 1.0	8	12.1	—	SM

LBR @ 0.1" Penetration

17612 Ashley Drive
Panama City Beach, FL 32413
(850) 249-NOVA(6682)
Fax:(850) 249-6683

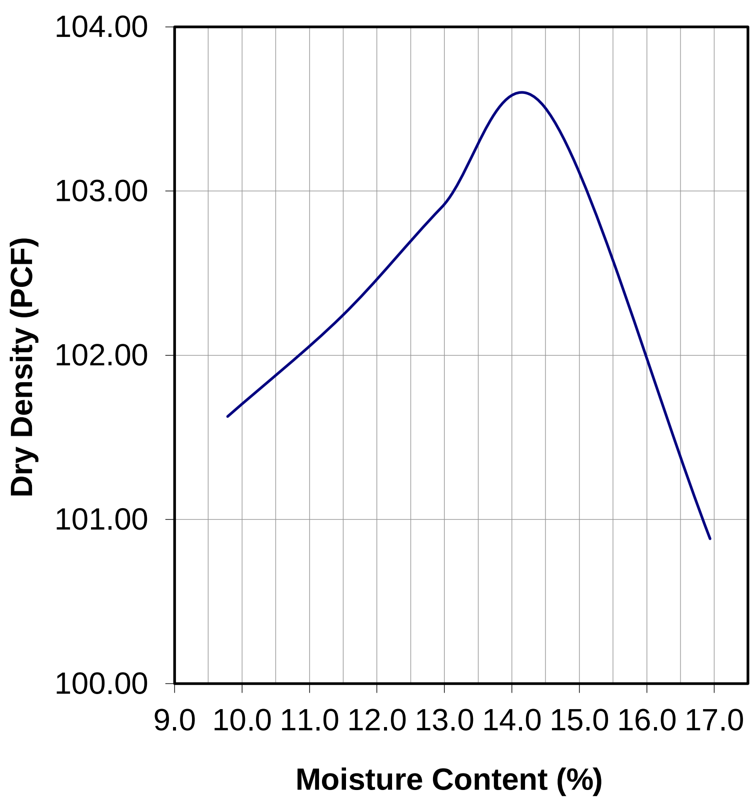


Report of Limerock Bearing Ratio (FM 5-515) and Modified Proctor ASTM D-1557, and AASHTO T-180

Project Name: St. Andrews State Park Improvements
NOVA Project Number: 10111-2020028
Report Date: March 25, 2020

Sample ID: LBR-1
Location: LBR-1/P-1 (1.0' - 1.5' BEG)

LBR RESULTS
(FM 5-515)
Maximum LBR Value: 50

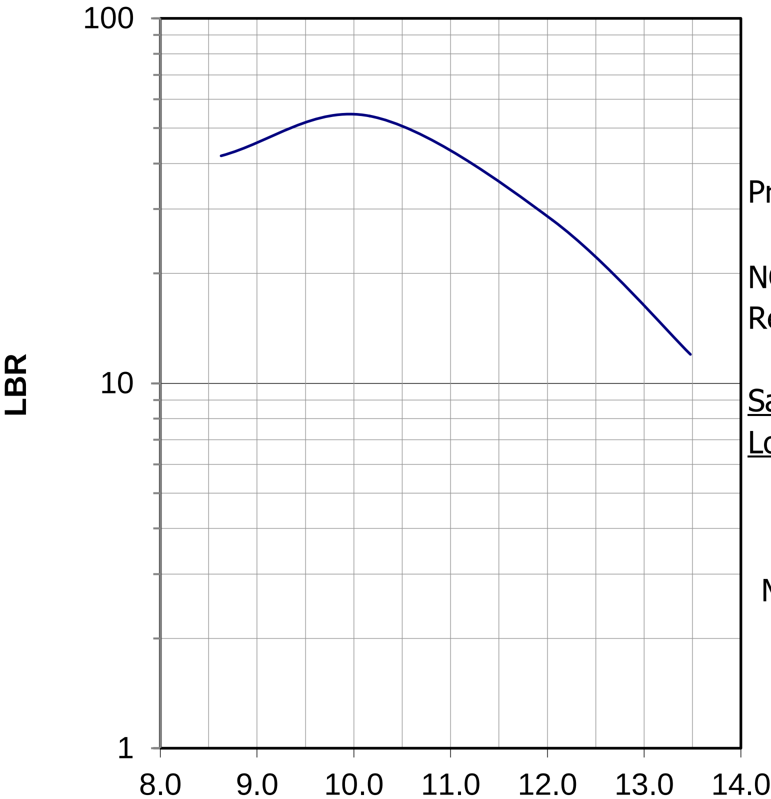


PROCTOR DATA
(FM 5-515)
Maximum Dry Density: 103.6 pcf
Optimum Moisture Content: 14.2 %
Fines Content: 3.3 %
Rammer: Mechanical
Specific Gravity (graphically): N/A
Sample Description: Grey/Light Grey Fine-Grained SAND
Proposed Use: SUBBASE/SUBGRADE

Kyle Ferachi
Certified FDOT LBR Technician

17612 Ashley Drive
Panama City Beach, FL 32413
(850) 249-NOVA(6682)
Fax:(850) 249-6683

LBR @ 0.1" Penetration



Report of Limerock Bearing Ratio (FM 5-515) and Modified Proctor ASTM D-1557, and AASHTO T-180

Project Name: St. Andrews State Park Improvements

NOVA Project Number: 10111-2020028

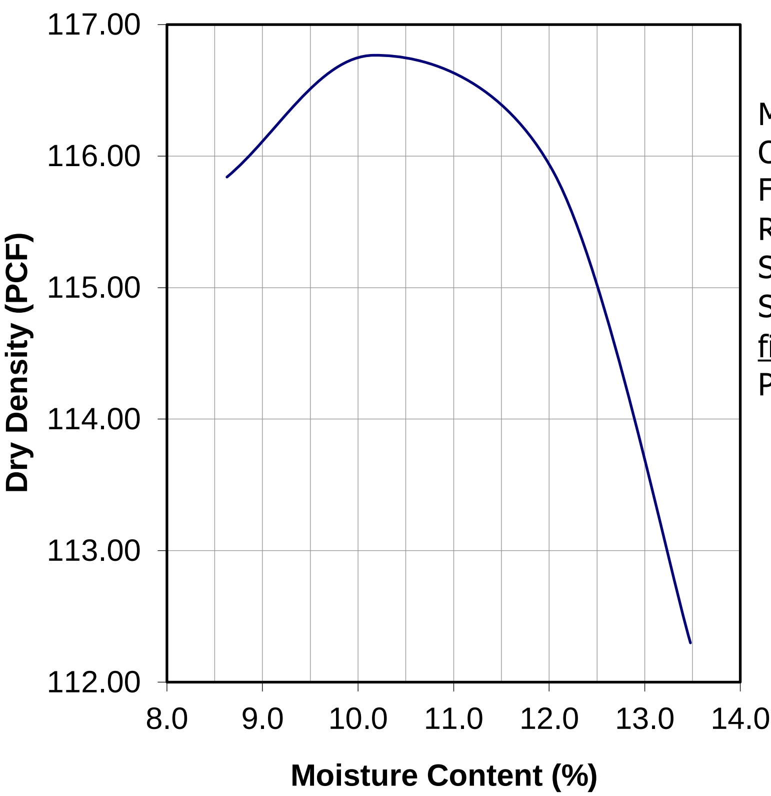
Report Date: March 25, 2020

Sample ID: LBR-2

Location: LBR-2/P-3 (0.25' - 0.75' BEG)

LBR RESULTS
(FM 5-515)

Maximum LBR Value: 54



PROCTOR DATA
(FM 5-515)

Maximum Dry Density: 116.9 pcf

Optimum Moisture Content: 10.7 %

Fines Content: 9.9 %

Rammer: Mechanical

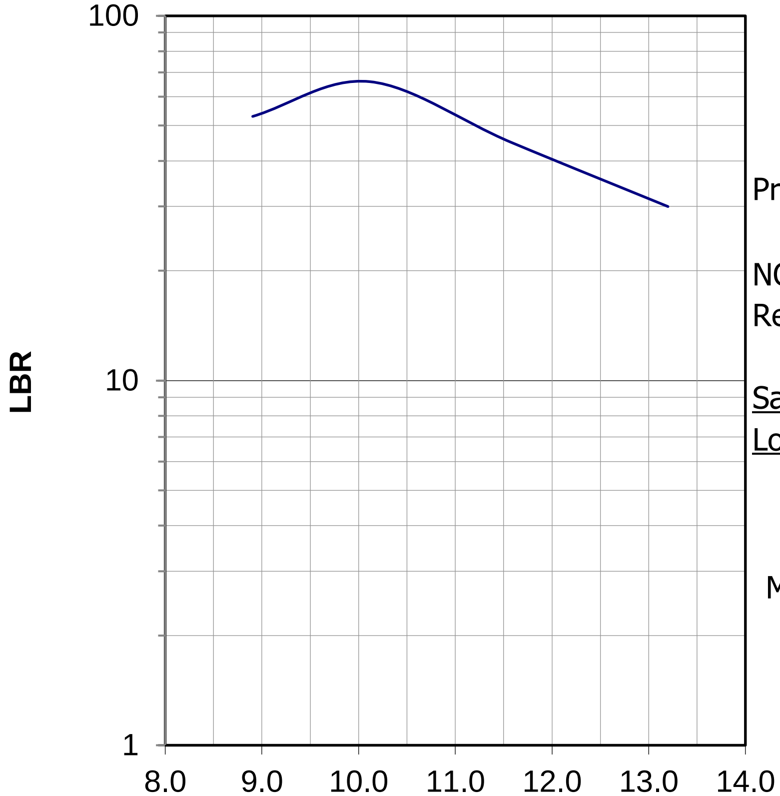
Specific Gravity (graphically): N/A

Sample Description: Brown/Orange slightly silty fine-grained SAND

Proposed Use: SUBBASE/SUBGRADE

Kyle Ferachi
Certified FDOT LBR Technician

LBR @ 0.1" Penetration



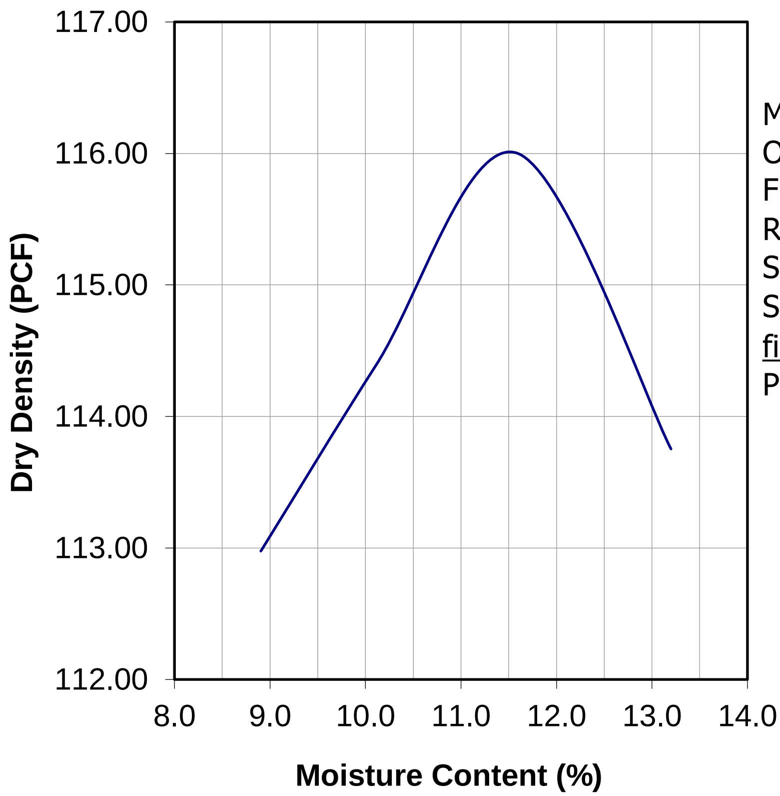
17612 Ashley Drive
Panama City Beach, FL 32413
(850) 249-NOVA(6682)
Fax:(850) 249-6683

Report of Limerock Bearing Ratio (FM 5-515) and Modified Proctor ASTM D-1557, and AASHTO T-180

Project Name: St. Andrews State Park Improvements
NOVA Project Number: 10111-2020028
Report Date: March 25, 2020

Sample ID: LBR-3
Location: LBR-3/P-6 (0.5' - 1.0' BEG)

LBR RESULTS
(FM 5-515)
Maximum LBR Value: 66



PROCTOR DATA
(FM 5-515)
Maximum Dry Density: 116.0 pcf
Optimum Moisture Content: 11.6 %
Fines Content: 11.0 %
Rammer: Mechanical
Specific Gravity (graphically): N/A
Sample Description: Brown/Orange slightly silty fine-grained SAND
Proposed Use: SUBBASE/SUBGRADE

Kyle Ferachi
Certified FDOT LBR Technician

APPENDIX D
Support Documents

QUALIFICATIONS OF RECOMMENDATIONS

The findings, conclusions and recommendations presented in this report represent our professional opinions concerning subsurface conditions at the site. The opinions presented are relative to the dates of our site work and should not be relied on to represent conditions at later dates or at locations not explored. The opinions included herein are based on information provided to us, the data obtained at specific locations during the study, and our previous experience. If additional information becomes available which might impact our geotechnical opinions, it will be necessary for NOVA to review the information, re-assess the potential concerns, and re-evaluate our conclusions and recommendations.

Regardless of the thoroughness of a geotechnical exploration, there is the possibility that conditions between borings may differ from those encountered at specific boring locations, that conditions are not as anticipated by the designers and/or the contractors, or that either natural events or the construction process has altered the subsurface conditions. These variations are an inherent risk associated with subsurface conditions in this region and the approximate methods used to obtain the data. These variations may not be apparent until construction.

The professional opinions presented in this report are not final. Field observations and foundation installation monitoring by the geotechnical engineer, as well as soil density testing and other quality assurance functions associated with site earthwork and foundation construction, are an extension of this report. Therefore, NOVA should be retained by the owner to observe all earthwork and foundation construction to confirm that the conditions anticipated in this study actually exist, and to finalize or amend our conclusions and recommendations. NOVA is not responsible or liable for the conclusions and recommendations presented in this report if NOVA does not perform these observation and testing services.

This report is intended for the sole use of Kimley-Horn & Associates, Inc only. The scope of work performed during this study was developed for purposes specifically intended by Kimley-Horn & Associates, Inc only and may not satisfy other users' requirements. Use of this report or the findings, conclusions or recommendations by others will be at the sole risk of the user. NOVA is not responsible or liable for the interpretation by others of the data in this report, nor their conclusions, recommendations or opinions.

Our professional services have been performed, our findings obtained, our conclusions derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices in the State of Florida. This warranty is in lieu of all other statements or warranties, either expressed or implied.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org